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THE BRICKBVILDER

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THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

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WHEN the use of terra-cotta was revived in England, some thirty years ago, it was then looked upon in the light of an innovation, rather than the re-introduction of a very old building material. Stone and brick, used separately or in combination, had become traditional and time honored in a land of invincible conservatism, whose people — whatever their views as to the first part of the proverb — "meddle not with him that is given to change." Notwithstanding this, terra-cotta was able to maintain a foothold, and of recent years its use has become general. Its durability is conceded, its utility no longer seriously questioned, while its susceptibility to various methods of treatment has been shown to exceed in many ways that of any rival material. These are qualities that appeal strongly to the sentiment, as well as to the business instinct of men who build not merely for their own but for succeeding generations. This, in a general way, is the secret of its growing demand in England, and, to some extent, the reason that underlies its popularity in America.

The estimation in which it is held in the two countries, however, differs considerably. That difference will, we think, be found to coincide with certain phases of national character (on which it is not at this moment necessary to enlarge), as well as with the relative climatic conditions. On this latter point, at least, comparison need not be odious, and may be made instructive. If, for example, bountiful nature has given us our full share of sunshine, there is no reason why we should not make the most of her gift. If, on the other hand, she has given England a moist atmosphere, with abundant supply of soft coal — therefore a comparatively gloomy outlook — its inhabitants do well to accept the situation without murmur or querulous complaint. They, however, have done and are doing more than this. Taking a leaf out of nature's own book, thay have sought to adapt themselves to their inexorable environment. With them terra-cotta has, to a great extent, superseded stone, but is *not* a substitute for, nor is it regarded as an imitation of stone. When chosen, it is by preference and in its own right; not merely on the score of economy, but in view of its greater permanence and, above all, because of its smoke-resisting properties. Hence, it is not used promiscuously on the cheaper classes of property, but usually on work of a very important character. It is almost invariably finished smooth, that it may offer less encouragement for soot to lodge on the surface. For a similar reason it is fired hard, and has a close, vitreous face, so that dirt may not penetrate the pores, causing lasting discoloration.

With us we fear it must be confessed that terra-cotta is often made to change places with stone solely from considerations of cost, or as a compromise, perhaps, between stone and cast iron. How often have we seen it placed in competition with galvanized iron, in which, alas, the cheapness of the latter, acting upon the cupidity of a sordid speculator, gained for it a preference otherwise inexplicable.

In most of the Eastern States, and wherever anthracite coal is the ordinary fuel, the smoke nuisance is not so serious. There is no telling what the future has reserved for us, even in this particular. It may be, as has been remarked metaphorically, that when our chimney has smoked as long as theirs the soot will be just as plentiful. The use of soft coal is certainly on the increase, and the air in all large cities is less free from the products of combustion than formerly. For the present, however, we can afford to stipple or scratch the face of terra-cotta, and sometimes go the length of tooling it "in imitation of stone."

A TOOLED surface cannot be claimed as a logical or natural treatment for a material of plastic origin, and one which, until finished and laid out to dry, is still susceptible to the lightest touch. The stiff mechanical regularity of six or eight cut work is in keeping with the rigid unyielding nature of stone. These cuts tell the story of its manipulation, from the time a large block leaves the quarry until the hewn stones are set in the building. Each cut represents a distinct blow of a mason's mallet on the steel tool by which the cut has been made. It suggests to the mind how stones have been shaped by a persistent use of these tools from time immemorial. We are aware that most of this work is now done by automatic machinery, producing a monotonous regularity, the imitation of which is all the more objectionable. But why attempt to imitate the surface texture of a hewn block in one that has been pressed into shape in a mold? In order to do so the mold has to be specially prepared, the required corrugations of six or eight to the inch being scratched in reverse by means of a steel templet. This, we understand, is the usual method; but whether it is merely the outcome of a conventionality of long standing, or done with deliberate, therefore dishonest, intent, the practice is equally anomalous, and should not be encouraged.

A similar but much more agreeable effect may be produced by the use of a toothed scraper, used directly on the face of each block shortly after it is taken from the mold. The toothing of the scraper may vary from eight to the inch, for work near the eye, to four to the inch on heavy work used on the upper stories of very high buildings.

When the tooling is done in the mold, every block coming from it is an exact duplicate, except in the case of blanks and otherwise defective impressions, which are not easy for the finisher to rectify. On the other hand, when done with the scraper no two pieces are exactly alike, though from the same mold and finished by the same man. These variations, and the slightly undulating movement resulting from hand finish, are among the things that invest the work with a higher degree of artistic merit. At all events, there is much to be said in favor of this method as against the one frequently adopted. Work that has been treated in that way has an added charm which cannot be expected from a series of stereotyped impressions needlessly deprived of all life and individuality.

SOCIETY, ASSOCIATION, AND CLUB NEWS.

THE Thirty-first Annual Convention of the American Institute of Architects will be held at Detroit, Mich., on Wednesday, Thursday, and Friday, Sept. 29, 30, and 31, 1897.

The full details of the program will be announced in a future circular. Papers will be submitted from Prof. C. Francis Osborne, F. A. I. A., of Cornell University; Mr. Henry Van Brunt, F. A. I. A., of Kansas City, and Mr. Cass Gilbert, F. A. I. A., of St. Paul, Minn., on Architectural Education, and its bearing on membership in the Institute. From Mr. Clipston Sturgis, F. A. I. A., of Boston, on Church Architecture, and Mr. H. Rutgers Marshall, F. A. I. A., of New York, on Architectural Truth.

The committee, to which was referred amendments to the Constitution and By-Laws, will report many and radical changes in the hope that they will be adopted, and that they will be so complete and harmonious as to preclude the necessity of changes for a long time to come.

Arrangements will probably be made for a reduction of railroad rates to one fare and a third for the round trip, but this can only be secured by a full attendance at the convention.

The president has appointed Mr. H. Langford Warren, Frank Miles Day, and the secretary of the Institute, committee on the part of the Institute, and the Michigan Chapter has appointed Mr. James Rogers, Jr., Henry J. Meier, Richard E. Raseman, and Frank C. Baldwin, the local committee of arrangements.

The local committee report that arrangements have been made with the Cadillac for headquarters for the Institute. Rooms and board may be had at the Cadillac for $3.00 and $3.50 per day.

THE Eighth Annual Convention of the National Association of Building Inspectors will be held in Detroit, Sept. 14, 15, 16, 17, 1897. The association was formed in June, 1890, for the express purpose of gathering and disseminating practical and useful knowledge, relating to the safe construction of buildings, introduction, and enforcement of the best methods obtainable of building laws.

The suggestions that will come up for consideration are of great variety and interest, among them being: —

Uniformity of safe loads for building floors. Adoption of a system of uniform definitions in building laws. Uniformity of tests of steel construction, and best methods of safeguarding the same against fire. Safe means of ingress and egress. Elevator inspection. Boiler inspection. Ventilation. Sanitation. Plumbing inspection. Gas fixtures inspection. Appointment of building inspectors. Best methods of enforcing building laws. Electric wiring in buildings, etc.

The headquarters of the association will be at the Russell House.

THE charter applied for by the T Square Club, the leading architectural organization of Pennsylvania, and one of the foremost in the country, has just been granted in the courts of Philadelphia, and the club is therefore duly incorporated under the laws of the State of Pennsylvania.

Although but now entering upon its corporate existence, this club has been an energetic organization and a moving factor in the field of its profession for the past fourteen years, having been organized in 1883. The following well-known architects were the founders: Walter Cope, John Stewardson, Wilson Eyre, Jr., R. G. Kennedy, Lindley Johnson, Arthur Truscott, George Paxson, Charles L. Hillman, Clement Remington, Frank Price, Louis C. Baker, and Mr. Carlton.

The purposes of the club, as set forth in the charter and in its constitution, are: "To promote the study and practise of architecture and the kindred arts, to afford its members opportunities for friendly competition in design, and to further the appreciation of architecture by the public." The subscribers to the charter, who constitute the present officers of the club, all of whom are well-known Philadelphia architects or draughtsmen, are: David Knickerbacker Boyd, president; Edgar V. Seeler, vice-president; George B. Page, secretary; Horace H. Burrell, treasurer; Walter Cope, Louis C. Hickman, and Charles Z. Klauder, executive committee, and Adin B. Lacey, Percy Ash, and Charles E. Oelschlager, house committee.

The T Square Club has made its influence felt in various municipal and national affairs, has passed important resolutions on progressive local and other matters, and last fall conducted the Architectural Exhibition in connection with the regular exhibition of painting and sculpture at the Pennsylvania Academy of the Fine Arts. This exhibition was one of the most successful ever held there or elsewhere, being the first in America to contain so many thoroughly representative contributions from foreign architects.

This fall will again see an architectural exhibition, held by this club, which, it is intended, shall surpass any previous one, both in the number and the interest of the exhibits. Representatives of the club are now in England and France, securing the best drawings, and a number of exhibits are promised from other countries.

The Club has also sent Mr. Albert Kelsey to represent it at the International Congress of Architects, to be held in Brussels, Belgium, in the latter part of this August.

PLATE ILLUSTRATIONS.

PLATE 65. A brick residence at Madison, N. J., Clinton & Russell, architects. A half-tone illustration made from a photograph of the building will be found on another page of this number.

Plate 66. Mr. Goodhue's splendid drawing of the church of St. Andrew by the Sea, Edgartown, Mass., Cram, Wentworth & Goodhue, architects. It is constructed entirely of brick, the interior being also finished in the same material. The main floor is of concrete, and in every respect the construction is of the most durable quality. The ceiling is of spruce, stained dark brown, and the finish and furniture of oak, the same color. The windows are filled with cathedral glass, in wide, heavy leads. The roof is covered with green slates. In spite of the nature of the construction, the cost of the entire building, including heating, furniture, pews, etc., will be $15,000, practically the sum that the same structure would have cost had it been built of wood. This church is the result of an attempt to build a small structure for a country parish, solid in construction, and with a certain degree of architectural effect, for a very limited amount of money.

Plates 67 and 68. An office building for the Proctor estate, Boston, Winslow & Wetherell, architects. The exterior of the building, with the exception of granite foundations, is entirely of terra-cotta ashlar. The results obtained in the designing and construction of this building are particularly successful, and as an example of the adaptation of the Spanish Renaissance to a modern building is very satisfactory. By the use of terra-cotta, the varied and elaborate ornamentation is carried out at a reasonably small cost when compared with carved stone.

Plates 69 and 70. Detail drawings of the building for the Proctor Estate.

Plates 70 and 72. Public bath houses at Crescent Beach, Mass., Stickney & Austin, architects.

The building is 80 ft. long and 75 ft. deep. On either side of the building are large yards containing commodious dressing rooms, to be used in connection with sea bathing. Connected with the building in the rear are two low, wooden sheds for the storage of bicycles. The yards are enclosed by the brick wall and the walls of the administration building, and by the bicycle sheds in the rear.

The monotony of the wall is relieved by the use of red and black brick placed alternately. Numerous entrances connect the main building with the yards.

The accommodations for the care of bicycles are beyond criticism. One may ride to the bath-house on his machine, and for five cents have it cared for. While in the bicycle sheds the machines are placed in racks that cannot injure the bicycles. There are enough racks provided to care for 1,225 machines at one time.

A small but complete hospital is connected with the establishment. A half-drowned bather, or any one suffering from accident, or overcome by illness, will receive prompt treatment in this room, which is on the lower floor of the building. Stretchers, an operating table, splints, a complete set of surgical instruments, and all other implements usually found in hospitals are here.

Near the hospital, and hidden from general observation, is a detention room, that will be used as a temporary prison for disorderly persons.

The laundry occupies the greater part of the upper story of the building. This laundry has a floor space of 80 by 70 ft. It is floored with asphalt, and the floor is guttered so that the water from the machines and condensation of steam is carried off into the drains.

Two gigantic washing machines are capable of washing five hundred suits at one time. After the suits have been washed they are put in two wringers, and all the water taken from them. They then go into large drying rooms, where the temperature is 210 degs. Fahr., and are dried within ten minutes. The suits then pass through the hands of an examiner, whose business it is to find rents in them, if there are any to be found.

Upon entering the building, the visitor finds himself in a large rotunda, very high studded, and finished artistically. The floor is of the finest asphalt. In this room hard wood railings guide the patrons along counters, at which they are to be served with keys, suits, etc. The men pass to the right and the women to the left. Behind these counters the large room for the storage of bathing suits is located, and is so arranged that suits of any size can be taken instantly from racks holding more than one thousand garments.

A person desiring to hire a suit and room first buys a ticket.

After securing a ticket, the patron passes along the counter to where the suits and keys of the rooms are given out. Then he passes a registering turnstile and goes into a small room, where he deposits his valuables. The system devised for the care of valuables is interesting and safe.

The valuables are placed in a large envelope by the patron himself, who then writes his name across the back of the sealed envelope. He is given a check that will secure the return of his valuables when he leaves his room after his bath. He receives his valuables from a room on the lower floor, directly below the apartment where he left them. They have been sent down on an elevator, and await him there. He is required to write his name on a book kept for that purpose, and thus he furnishes a positive identification of his envelope and a receipt for the goods.

After the customer has deposited his valuables he passes out into the yard containing the dressing rooms. The men's yard is much the larger, and contains 602 rooms. The women's yard contains 400 rooms. The dressing rooms are arranged on two tiers, or stories, and are planned so that the corridors on the basement story are open to the sky as well as those on the upper tier. The bath-houses in these yards are roofed with gravel and tar. They average 4 ft. by 6 ft. on the lower tier, and 4 ft. by 4½ ft. in the upper story. Only one person is allowed in a room, except where small children are accompanied by parents or guardians. Each room contains a good plate glass mirror, and each bather is furnished with a large Turkish towel.

When prepared to go into the water the bathers reach the beach through subways or passages that go under the boulevard and the shelter that is in front of the bath-house. This is one of the greatest features of the whole establishment, and will be welcomed by those who do not care to go through a crowd of loungers while in bathing costume.

The care for the comfort of the bathers continues even after they have left the subway, for long runs of asphalt have been constructed so as to reach far toward the water's edge, thus relieving the barefooted bather from the pain of walking over the pebbles near the crest of the beach.

After leaving the water, entrance to the bath-house is gained by the same subways, and here the bathers find shower and foot-baths ready for their use.

ILLUSTRATED ADVERTISEMENTS.

IN the advertisement of Fiske, Homes & Co., page vii, is illustrated another of their new and handsome designs of brick and terra-cotta fireplace mantels. The mantel is designed by H. B. Ball, architect, and rendered by H. F. Briscoe.

The Excelsior Terra-Cotta Company illustrate in their advertisement, page iv, a series of terra-cotta details used in the new build-

EXECUTED BY THE NEW YORK ARCHITECTURAL TERRA-COTTA COMPANY.
J. E. Sperry, Architect, Baltimore, Md.

ing, corner Waverly Place and Greene Streets, New York City. R. Maynicke, architect.

The new bank building, Montogue Street, Brooklyn, Wm. H. Beers, architect, is shown in the advertisement of the New Jersey Terra-Cotta Company, page viii.

A residence at Alleghany, Penn., Longfellow, Alden & Harlow, architects, is shown in the advertisement of Harbison & Walker, page xxv.

Another residence at Chicago, of which A. F. Hussander is the architect, is illustrated in the advertisement of Charles T. Harris, Lessee Celedon Terra-Cotta Company, page xxix.

Three views of a half-timbered and stone residence, Renwick, Aspinwall & Owen, architects, are shown in the advertisement of the Gilbreth Seam Face Granite Company, page xxxviii.

Brick versus Wood. II.

BY R. CLIPSTON STURGIS.

IN my previous article I have considered the advisability of using brick in preference to wood on account of its durability, economy, and beauty. I want now to show how wide has been the use of brick, and with what admirable results it has been used for all sorts of places and for all classes of buildings.

In the city one naturally expects to find brick; compared with other fire-resisting materials it is cheap, and has, therefore, every reason to commend its use. It is, indeed, somewhat curious, under these circumstances, to find anything else used for mercantile or business buildings, for it is cheap, easily obtained, quickly laid, and, above all, the most fire-proof of all materials.

WORTHINGTON BUILDING, STATE STREET, BOSTON.
Fehmer & Page, Architects.

There seems, however, a general feeling that stone, however common, even if it be mere split granite, is finer or more imposing than brick; and one has recently seen the incongruity of a fine building, open on four sides, faced on the two important sides with plain, dressed granite, without relief or ornament (unless a metal cornice may count for such), and red brick on the two other sides, equally exposed to view, and yet deemed less important.

An harmonious whole of good brick would certainly have been better, and probably cheaper.

The illustration of the Worthington Building, State Street, Boston, is a good example of simple yet dignified brick in an office building.

That it is not unsuited for a city house, even one of some dignity and cost, is, I think, fairly well shown by the Lyman House, on Beacon Street, and the charming houses on the Bay State Road, Boston, by Wheelwright, and by Little and Browne.

As soon as one gets outside of the fire limits, however, one finds brick discarded for houses, though the fact that even here it is sometimes used for buildings of more importance shows that it is looked upon as a material superior to wood.

The fear of expense, which I tried to show groundless in my last article, is, doubtless, still the chief cause for our wretched wooden suburbs. If only people would realize how inexpensive, how neat, and how compact is a suburb nicely laid out with brick houses, perhaps they would be led to at least try the experiment of a brick house for themselves. I have shown in an illustration of the first article a few cottages in Bedford Park, a London suburb. They were built by Norman Shaw, and were, I believe, inexpensive houses; and for good cheap cottages I would refer the reader to some of the facts and figures about the brick cottages built on some public land by the city of Birmingham, and forming a paying investment when rented at eight pounds a year.

CHARLESGATE STABLES, BOSTON.
Peabody & Stearns, Architects.

I am sorry to say that I cannot illustrate many good examples of cheap brick suburban houses in this country, because there are so few. The brick blocks which have here and there crept out from the city are mere city blocks, generally poor ones at that, misplaced, but the one illustration I have (a house in Newton) is a good one, and I hope may be productive of more like it.

If the ordinary householder is prejudiced against a brick house in the suburbs, his face is rigidly set against it in the country. Here it is not only the argument about expense, but also the plea as to the appropriateness of wood in the country. For myself, I can see the appropriateness if it is a really wooded country and the timber is at hand, just as stone becomes appropriate if one lives by a quarry; but otherwise I see no reason why brick is not far more appropriate, for if you anywhere want a permanent, dry, warm house, it is in the

LOWER SCHOOL AT ST. PAUL'S, CONCORD, N. H.
Henry Vaughn, Architect

country, where you are exposed on all four sides to wind, and rain, and sun. If anywhere you want a house wall on which you can grow vines without tearing them down every few years to paint, it is in

RESIDENCE, BAY STATE ROAD, BOSTON.
Little & Brown, Architects.

the country. If anywhere you want a wall which requires little care or repair, it is in the country, where mechanics are not always convenient or competent. Brick seems to me, then, appropriate for city, for suburb, for country; and if appropriate for these various localities, it is also appropriate for the various classes of buildings, for houses, as we have said, and also for churches, public buildings, warehouses, and barns.

In churches we can point to many beautiful examples. There are the churches and towers of Rome; the Frari in Venice. There are many interesting massive towers of the Lowlands (Flemish and Dutch) which have been illustrated in a previous article in THE BRICKBUILDER. Here and there a good bit in England. Some old, like St. Albans tower. Some new, like Holy Trinity, Sloane Square, (Sedding's) — and as a modern following of Italian ways, the Judson Memorial Church on Washington Square, New York, the work, I think, of one of that gifted firm who have done so much for American architecture. These are no mean examples to show that brick has its place in church architecture.

HOUSE AT NEWTON, MASS.
E. H. Benton, Architect.

To pass from church to public buildings, one might call to mind Shaw's Scotland Yard in London, or our own modest little Independence Hall, and one might add innumerable town halls in Holland, and the St. James Palace in London. There are not, however, many important examples among large public buildings; much yet remains for brick to do in that field.

If schools come under the head of public buildings, we can point to numberless examples: Vaughn's Lower School at St. Paul's, and Wheelwright's well-known work for the city of Boston, buildings very different in their style and yet each charming in its way. Vaughn's work has little or no attempt at ornament, very quiet and refined, distinctly English in its whole feeling, looking thoroughly suited for its purpose, and most naturally English, for to England we must look for precedent in such schools; and Wheelwright's work, of ornamental brick, Italian in character, yet distinctly scholastic. Red brick is not wholly to be commended for interiors, and the halls and large rooms of Vaughn's school, which show dark-red walls,— red jointed, too,— are somber and forbidding, hardly a cheerful atmosphere for study. There are very many excellent examples of good brickwork in this class, but there is plenty of room for improvement and for a more general use of brick.

Under warehouses we can include the familiar great Cloth Hall

RESIDENCES, BAY STATE ROAD, BOSTON.
Wheelwright & Haven, Architects.

at Ypres; and the Waag at Amsterdam, and innumerable good buildings in our larger cities, of which the storage warehouse is a specially apt example, for we here have a building of considerable merit, and yet hardly a single opening to give opportunity to the architect. And we might in this class include that delightful brick and stone stable and carriage storehouse which Mr. Peabody built in Boston. And finally, in England we find real barns here and there, and plenty of stables of good honest brick, which speaks of certain assurance of permanency, and gives us a comfortable feeling that the owner expects to work and live long, tilling the soil and garnering his hay and corn. These buildings show brick in an attractive light from every point of view, — economical for the investor to build, a good risk for the insurance companies, and a beautiful building to delight the artist. And we see that there is most excellent precedent for the use of brick, in city and country, for houses and churches, for public and private buildings.

Architectural Terra-Cotta.

BY THOMAS CUSACK.

(Continued.)

THE Chamber of Commerce Building, Rochester, N. Y., designed by Messrs. Nolan, Nolan & Stern, of that city, affords an excellent example of terra-cotta architecture, in which that material is used consistently, in combination with brick, from sidewalk to corona. The first and mezzanine stories are, perforce, an expanse of plate glass, admitting of nothing save a series of piers, windows and doorways, of which, however, the most has been made. On the story above, with its rusticated piers and two horizontal courses, entirely of terra-cotta, considerable elaboration has been bestowed; at the same time the idea of homogeneity, so much needed at this point, is happily preserved. The succeeding eight stories are exact duplicates, and in this the exterior proclaims the nature and purpose of the interior with admirable candor. In the twelfth story, which is also wholly in terra-cotta, the laws of perspective, and the effect of foreshortening have been studied to some account. Figs. 29 and 30 will show that the embellishments have been carried out on a scale that is legible from the street, and not, as too often happens, reserved for the delectation of the feathered tribe.

This building has already been briefly referred to in connection with banded columns, of which it has two very good ones at the principal entrance. The business at present in hand is primarily one of cornice construction, and of that, too, it affords a typical example that may now be described, and made the subject of adequate illustration.

This cornice is 8 ft. 9 ins. high, and, having a total projection of 5 ft. from wall line to nose of lion's head, requires a well-devised scheme of structural support. The one that was adopted is shown in detail at Fig. 31. To the Z bar columns that extend up through the piers is bracketed, horizontally, a 10 in. I beam. This acts as the fulcrum to a series of 6 in. I beams that project over each modillion, the opposite end of which is attached to roof beams by means of a stirrup. These cantilevers, in addition to the weight that rests on top of them, are strong enough to support the modillions also. This they are made to do by the application of two ⅜ in. hangers, which, taking hold of a short bar inserted in the modillion, pass up through a plate laid across the cantilever, and are then tightened up to required tension. The dental course, and the panels between modillions have each a hole into which a rod is passed, and from it they are anchored back through the wall.

The modillions are spaced on 3 ft., 8 in. centers, which, all things considered, rendered it inadvisable to make the soffit blocks in a single piece. They are therefore jointed into three, for greater convenience of handling and of setting, as well as in the making. This allows the two side pieces to be fitted into the flanges, and bedded down on each side of the cantilever. The center piece, to which the coffer panel is attached, is then dropped in as a key, and the whole course is thus made immovable. A hole is provided in blocks forming cima, into which short pieces of round iron are inserted, and from those they are secured by diagonal braces at intervals, riveted to the 6 in. I beams, as indicated in section. In view of subsequent criticism and comment on the deterioration of iron and steel, when used in a similar way, let it be noted that the top surface of this cornice like the one given in last example, is also covered with copper.

FIG. 29. CHAMBER OF COMMERCE BUILDING, ROCHESTER, N. Y.
Nolan, Nolan & Stern, Architects.

Among recent communications on the subject of cornice construction, there is one from Mr. J. E. Sperry, of Baltimore, that calls for special notice. In it he reaffirms the superiority of cast iron as distinguished from rolled sections. As for steel, he doubts the propriety of using it at all, in situations where it is likely to suffer from rust, adding: "I should hesitate to use structural steel, except in the inside of a building where it was not liable to be assailed by dampness. In cornice work, though the steel is in a measure protected by terra-cotta, it would not be entirely free from atmospheric influences, which would in the course of time cause disintegration not likely to occur in the case of cast iron."

Mr. Sperry is probably right in discriminating between iron and steel sections, and in giving the preference to the former of these two materials. The introduction of steel for structural purposes has been so recent that there has not been time for a conclusive test of its comparative durability. Its flexibility, as well as its stiffness, is allowed to be much greater than those of iron, but we think it is generally conceded among engineers that it should not be subjected to varying

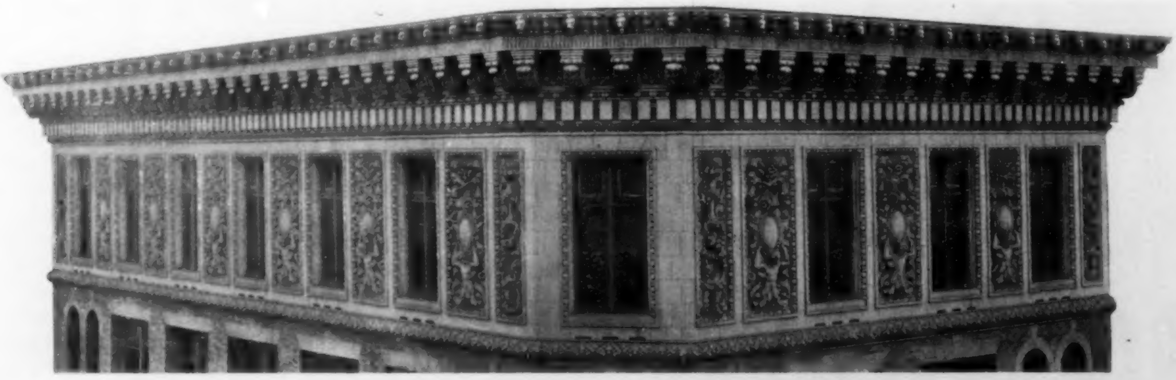


FIG. 30. TWELFTH STORY CHAMBER OF COMMERCE BUILDING, ROCHESTER, N. Y.

degrees of dampness, from wet to dry, and in situations where it cannot be repainted. We have noticed a marked deterioration in the case of corrugated roofing plates, even when galvanized, and though steel is now the more generally used of the two for that purpose, its popularity is probably owing to its relative cheapness, and not to anything that can be said in favor of its durability. The laminæ in the texture of steel is more pronounced than in that of iron, and the scaling off that follows as a result of, oxidation appears to be correspondingly rapid and destructive in its action.

In the case of cast iron, however, it must be remembered that it, too, has defects of another and far more treacherous kind, which it is difficult to detect, and impossible to guard against even under the most rigid supervision. Sand-holes and blow-holes frequently occur in ordinary castings, but they are usually concealed by a convenient coat of paint, for which most foundrymen evince an easily understood predilection. It is for this reason that cast iron has been abandoned in bridge building, and is now superseded in all structural work where the load is eccentric and the strain as variable as the wind pressure.

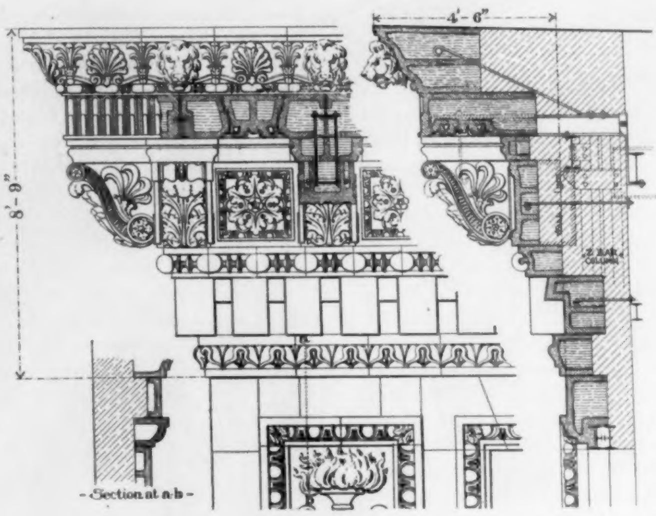


FIG. 31.

The foregoing objections to the use of rolled iron are valid up to a certain point, but by no means vital. We have already urged, as a sufficient set-off, the advisability of having all hangers, anchors, and cantilevers galvanized. This is now being done on several buildings in course of erection, one of which is in Baltimore, and for it we are pleased to know that Mr. Sperry is the architect. The new Delmonico Building on Fifth Avenue and 44th Street, New York, is another, and on it Mr. J. B. Lord has insisted that all special ironwork coming into contact with the terra-cotta be galvanized. When this is done there is no room for hesitation in the use of wrought iron, and no reason to doubt the permanent security of a properly constructed terra-cotta cornice, with it as the chief auxiliary support.

As a further step in the right direction, attention has likewise been directed to the importance of keeping water from entering the joints. This, however, is one of the things so frequently neglected that it may be well to reiterate the warning, and at the same time to indicate some of the ways in which the desired end may be attained.

A covering of copper, on all surfaces having a wide projection, is one very effectual method; but a fatal error is often made in the provision for fastening down the outer edge. Instead of turning the metal clear over the nose, as at A (Fig. 32), or providing a roll and quirk some distance back, as at B, architects sometimes call for a raggle to be sunk into the top surface, as at C. This latter plan may appear all right on paper; it may also satisfy a draughtsman who looks upon his drawing, not as a means to an end, but as an end in itself. In practise, however, it is a most objectionable method, and is liable to promote some of the things it had been intended to prevent. When the edge of the copper has been inserted in this groove, the metal worker drives in, at intervals, lead plugs to hold it down; if lead is not at hand, he contents himself with wedges of wood, which serve his turn as well. The mason then fills up what is left of the raggle with mortar or cement, which remains until after the job has been cleaned down. If well done, this may remain for a year or two longer, but it cannot be regarded as permanent. When it wears out — as sooner or later it is bound to do — this channel gets filled with water, which soaks into the blocks, and expands every time the temperature falls below freezing point. The nose, which has been weakened by the groove in the first instance, is then liable to break off, and whether it be from the third or from the twenty-third story, when it falls the consequences are equally disquieting. In work of a light color an architect may not want the copper to show on top member of cornice. In that case he has the alternative method at B, to which there can be no reasonable objection, and by adopting it he escapes all risk of a disaster such as he invites by making a groove along the wash.

Where a copper covering is not provided, the joints may be rendered perfectly secure in the way shown at D, Fig. 32. A dovetail rebate is molded in the ends of the blocks, as drawn in section at X. X. Vertical channels are likewise made to receive grout, which is poured in from the top, after the course has been set to line. The dovetail cavity so formed is then filled flush with granolithic; or a good brand of cement gauged with an equal quantity of clean, sharp sand may be used. A filling of this kind cannot work out, and the size of the body is a guarantee against its cracking or scaling off. Several important cornices, with the particulars of which the writer is acquainted, have had the joints protected in this manner, and in every instance with good results.

One of these was set about six years ago, and we can say, from a critical inspection made at the date of writing, that the joints are still in perfect condition, though nothing whatever in the way of pointing has been done during that interval. Let the blocks receive a hard metallic glaze (on the wash only), and let them be fired to the point of vitrifaction; no other covering will then be necessary, and a cornice so constructed will continue intact as long as the building remains in existence.

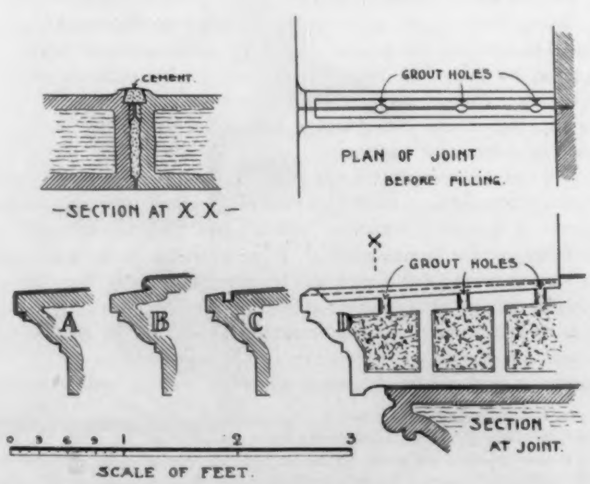


FIG. 32.

Continued.

The Art of Building among the Romans.

Translated from the French of AUGUSTE CHOISY by Arthur J. Dillon.

CHAPTER III.

PART III.

HISTORICAL ESSAY ON THE ART OF BUILDING AMONG THE ROMANS.

CHAPTER I.

FORMATION AND DECLINE OF LOCAL METHODS.

LOCAL SCHOOLS.

IT happens that in demonstrating the methods of the Roman art the examples cited in support of the same idea have been taken from different countries, and even sometimes from different epochs. It may be asked if the Roman art had such unity that it is possible to thus compare monuments of so many different provinces and centuries; the question is answered in part by the uniformity of the results of such a comparison. But let us be careful, however, of exaggerating this uniformity; it existed, it was possible, only in the principles, and excluded neither the progress that comes from the long practise of the same methods, nor those slight variations which arise in any system of construction in the process of adaptation to different climates. Construction had its local schools; it escaped neither the influence of foreign examples nor the vicissitudes of the internal condition of Rome. Tuscan when Rome was still one of the cities of Etruria, it took bit by bit the imprint of the Hellenic spirit, when brought into contact with Grecian civilization; and its originality lay less in creating new types than in grouping those already existing into a new system. We have indicated, in speaking of cut-stone construction, some of the ideas taken from Greece and Etruria; in order to mark these more clearly, and to decide the circumstances which brought foreign methods into use among the Romans, it would be necessary to enter into the field of conjecture, and to study the art of building in connection with the political relations of Rome. We will not attempt this difficult research; leaving aside the period when the Romans were satisfied in imitating the models of Etruria or of Greece, we will take as a starting point the time when they initiated the only methods that are strictly their own, those of concrete construction.

The appearance of concrete vaults in the Roman monuments must be placed at the last years before the Christian era. No doubt long trials had prepared for this important innovation, but no certain trace of them can be found either in ruins or in books. Vitruvius himself, writing but a few years before the laying of the foundation of the Baths of Agrippa, does not seem to suspect the great part that concrete vaults are about to play. The art of which he treats was at the point of entire transformation, yet nothing authorizes us to conclude that Vitruvius foresaw this change: so rapid was the progress of concrete construction, so sudden and unexpected was this revolution of Roman architecture.

What causes, then, determined this brusque revolution in the art under the government of Agrippa? Several come so naturally to mind that it is sufficient to mention them; public wealth had increased suddenly after a period of internal commotion and foreign war; thanks to an interval of calm, the new methods were applied on a grand scale for the first time, and had an opportunity of bold development; Agrippa saw in the embellishment of Rome a means of making its people forget their ancient political life, and put himself at the head of the movement; under his administration Rome was filled with edifices consecrated to the pleasures and festivals of the Romans; the ancient city was soon too small to contain all of them, and it became necessary to infringe even on the Field of Mars. It is, I think, in this double influence of customs and politics that the causes of the sudden advance in the art of building at the commencement of the imperial rule must be sought. Methods were henceforward definitely fixed, and the art of building, once systematized, remained stationary at its highest point of perfection for a period of more than three and one half centuries.

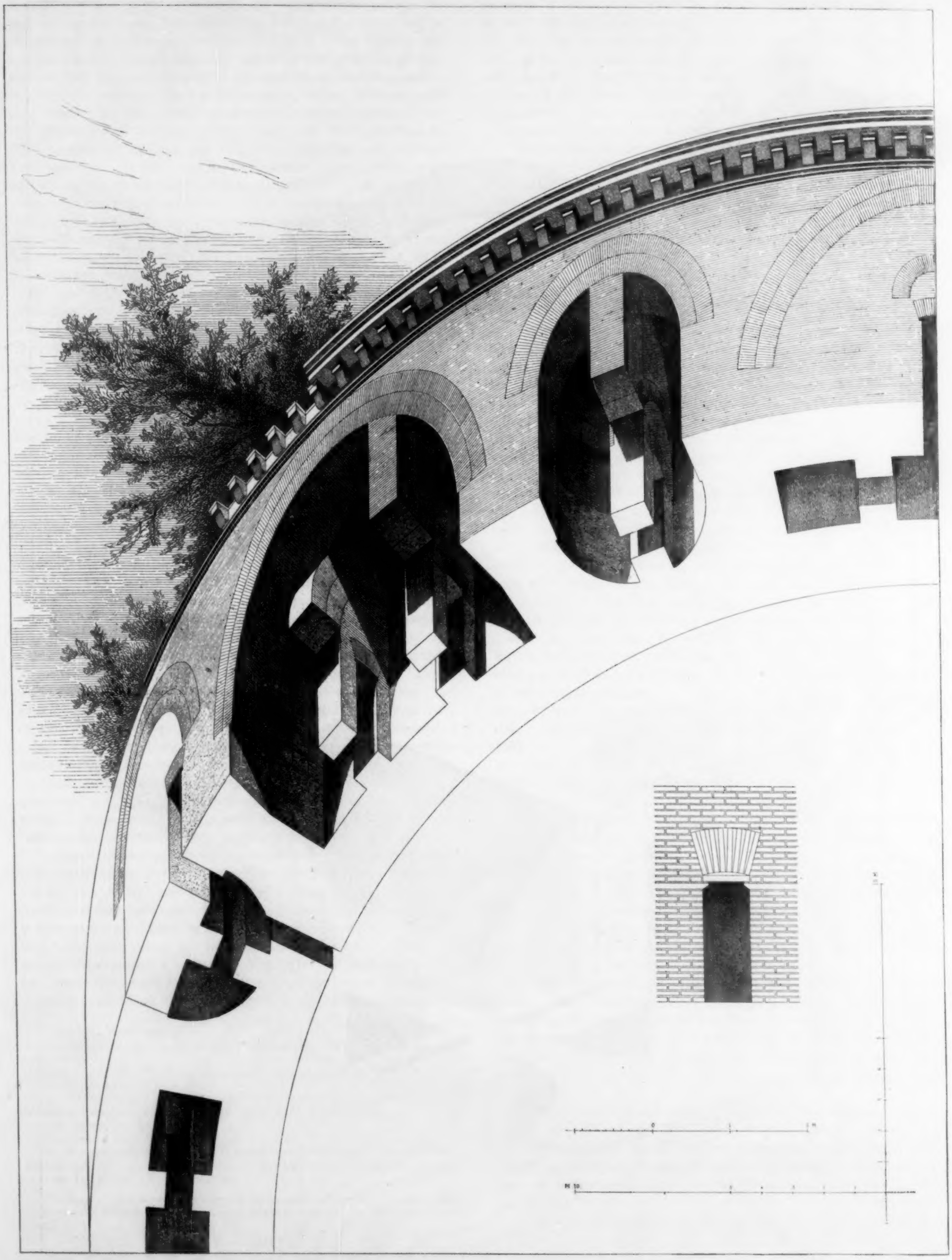
This fact, remarkable in itself, becomes of great interest when it is considered that it was during the decline of all the arts that the traditions of good construction were preserved without alteration—and also without progress. Even the causes that affected architecture seem to have had little or no influence on the art of building; ornament and construction had become almost entirely independent; and hence their development or decadence was according to different or even contrary laws. Under the Antonines construction was the same as under the Cæsars, although architecture was visibly modified in the intervening century. At the end of the third century architecture was in full decadence, while the art of building, still flourishing, produced the Baths of Diocletian. After Diocletian, art still degenerated; and, by a curious coincidence, the architects who could do no better than strip a monument of Trajan to ornament an arch of Constantine were the contemporaries of the daring builders who covered the naves of the Basilica of Maxentius with those magnificent vaults whose ruins still amaze us by their solidity and grandeur.[1] Never had the art of decoration and the art of building offered a stranger and more striking contrast. The discord was at its height, but it was also approaching its end; and under the reign of Constantine, the art of building fell to that degree of abasement which architecture had long before reached.

The fall was as brusque as the progress had been rapid; it was but scarcely announced by a few monuments built without due care, such as the circus of Maxentius, near the Appian Way; and at the side of these mediocre productions, practical architecture did not cease to show by its *chefs-d'œuvres* that the old traditions were still maintained. But suddenly this prodigious fecundity was exhausted, and the art of building reverted, as it were, to the point where it had started four centuries before. Its progress had been in the development of vaults, its decline was marked by their almost absolute abandonment. First the traditional methods were used timidly; the monuments of St. Constance and of St. Helen, at the gates of Rome, show the characteristics of this first period; and perhaps we must put at the same date the curious monument called Minerva Medica, where the vacillating and awkward use of the classic methods clearly marks the moment of hesitancy that precedes the centuries of decadence. Vaults — spherical vaults among them — did not cease to be used in sepulchral or religious monuments, but they disappeared almost completely from the great civil buildings. The Christian basilicas of the fourth and fifth century had no vaults, except such as are represented by the arches that spring from column to column; all the rest was roofed with wooden framing. Two centuries went by during which vaults, used only in buildings of little importance, ceased to dominate the general system of construction, to reappear again at the time of the Byzantine Renaissance, but under an entirely new form. The old tradition was definitely broken at Rome,[2] and the rapidity of the changes that took place seems to indicate a cause as violent as it was sudden.

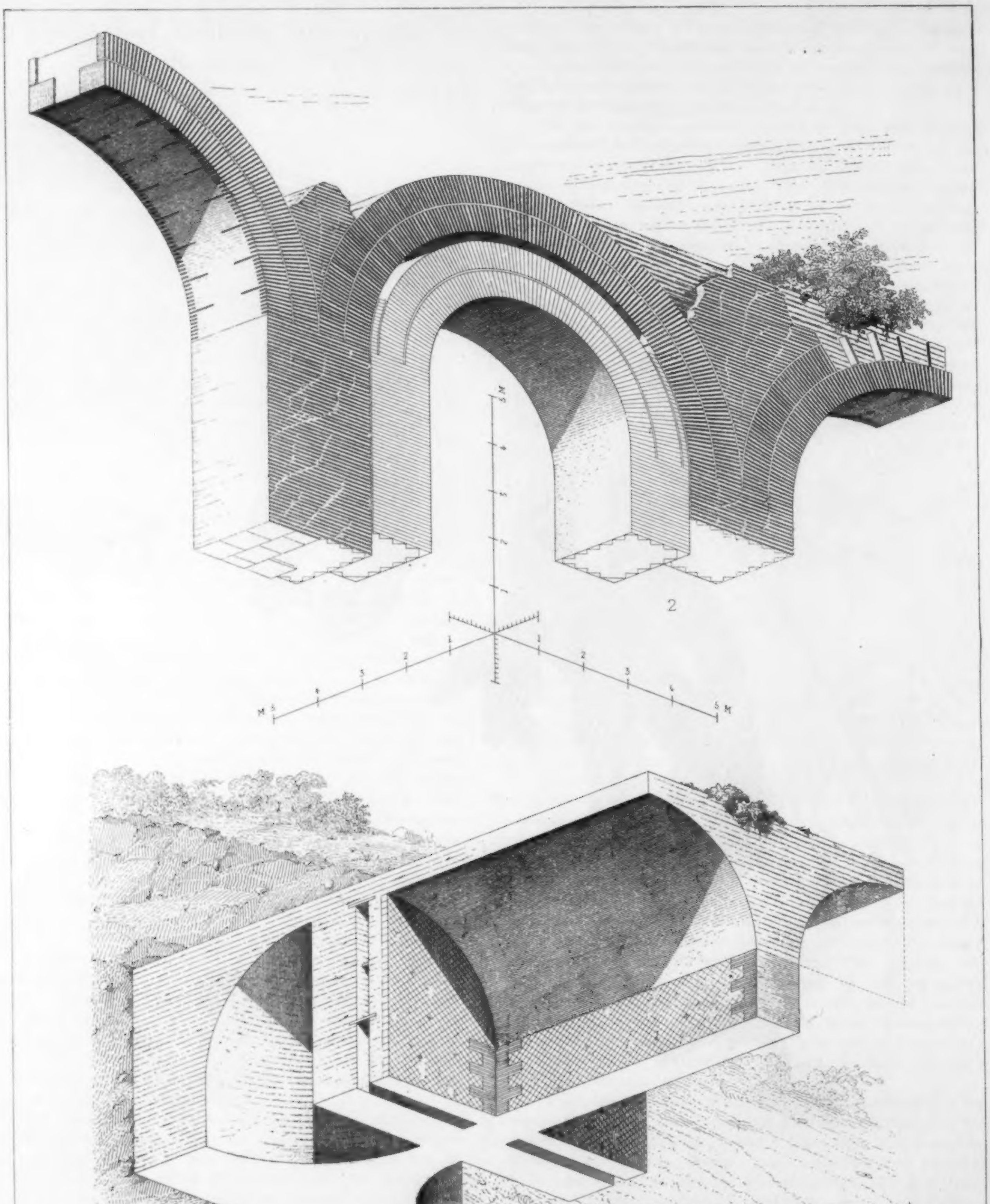
In fact, between the time of Diocletian and the last years of the reign of Constantine, a revolution took place whose influence on the history of Roman construction was not less than its influence on the history of the Roman empire. Rome ceased to be the capital of the Roman world; and the art was transformed the day that Rome, losing its political preponderance, ceded to Byzantium the inheritance of its ancient privileges. The immense buildings of the new capital immediately absorbed the resources of the empire, and the date of its foundation (330) marks the epoch when the sudden and profound

[1] For the actual date of this building, called the Basilica of Constantine, see W. A. Becker, Handbuch der römischen Alterthümer, Part I., pp. 438 et seq.

[2] In some provinces the rupture of the old traditions was less sudden; thus, in the northern part of Gaul, construction was carried on, under Julian, on a scale that recalls that of ancient Rome. The Baths of Paris can with some reason be placed at this date; and their superiority over contemporary edifices in Rome is incontestable.



PANTHEON D'AGRIPPA.
PLATE XIII. THE ART OF BUILDING AMONG THE ROMANS.



1. Villa Hadriana. 2. Aqueduc Pres St. Jean de Latran.

PLATE XIV. THE ART OF BUILDING AMONG THE ROMANS.

transformation of Roman construction, whose principal characteristics we have shown, took place. This explanation must not be thought a pure conjecture. We have the proof of its truth in the singular demand which Constantine made on the pretorian prefect, ruler of both Italy and Africa, to supplement the exhausted resources of Italy: "Architectis quam plurimus opus est, sed quia non sunt . . . " such is the beginning of the first constitution of Constantine on the immunities of artisans (Cod. Theod., Lib. XIII., it. VI., l. 1). This constitution is dated 334, four years after the foundation of Constantinople. It was impossible to formulate more clearly, in an official act, the causes of the decline of architecture in the fourth century. Constantine established schools to save the remains of the ancient art; he founded institutes for the benefit of the young Romans who would agree to devote themselves to the study of architecture; but the efforts were fruitless; new demands had arisen, to meet which it was necessary to do no less than to create an entire system of entirely new methods. Another capital of the world could not be planned with that luxury of material and immovable solidity which we so admire in ancient Rome, when arms were lacking, when means of subjection had to continually be increased in order to obtain sufficient corvees, when even directors of the works were missing. Lighter construction, sacrificing solidity to the demands of endless necessities, was sought; and the venerable practises of the Roman art partially disappeared in the course of this change; the old equilibrium of the working classes was overthrown, and the tradition that had lasted from Augustus to Constantine was suddenly discontinued.

At the same time that the buildings of Constantinople were draining the resources of the empire, the magistrates of the provinces were, in their turn, endeavoring to transform their own residences; and the taste for building increased everywhere just when the means of satisfying it were becoming more and more insufficient. It became necessary to arrest this fad by the constitutions that are repeated, as one might say, on every page of the Code,[1] whose number is in itself an indication of their failure to accomplish their purpose. It was in vain that the emperors prohibited the erection of new public buildings before the completion of those already commenced; it was in vain that they tried to limit the number of these useless works by depriving the magistrates of the honor of placing their names on them; it was in vain that they imposed the onerous duty of assuring their complete achievement on those who commenced them: for fashion, stronger than imperial commands, immeasurably multiplied these senseless enterprises; and the lack of resources, day by day more marked, continually put the builders further from the good traditions of the ancient school. A small number of the monuments of this epoch have lasted until the present time; they are the basilicas, whose duration was prolonged by the pious care of the Christians; but the majority of the buildings of Constantinople had to be rebuilt by the Byzantine emperors. The historian Zosimus even affirms that several collapsed under the reign of Constantine, so hastily had they been constructed. This author, a thorough pagan, is open to the accusation of partiality when he speaks of Constantine, his government, or his religion; his animus can be perceived even in the expressions he uses in speaking of the monuments built by Constantine;[2] nevertheless, his testimony at least shows that the buildings were short lived; and their anticipated ruin seems due to that lack of resources of which the memory has been transmitted to us by the imperial constitutions.

Such was, to sum up, the history of concrete construction; a singular history, whose phases do not seem to follow, as do those of other histories, a law of general continuity. The great decadence of the fourth century was brought about, like the great rise of the last century before our era, without a transition whose monuments might make it possible to retrace its course.

It is no part of our program to study the Roman art such as it became after this last transformation. We have been compelled to limit ourselves to what it was during the long period that commenced during the last years of the republic, and ended at the epoch of the barbarian invasions. Let us now give a glance at the variations that were made in the methods in the different parts of the Roman world.

LOCAL SCHOOLS.

THE ROMAN ART AND THE MUNICIPAL SYSTEM OF THE EMPIRE.

When the Romans invented the system of concrete construction, they certainly created the most suitable instrument for making the methods of the art of building uniform. When they had learned how to erect their colossal vaults, with no other workmen than unskilled laborers, with no material but shapeless stones and mortar, they seemed to have obtained a mode of construction that was destined to become universal. By means of their colonies and legions they pushed the new methods to the farthest limits of the empire. At every point to which the domination of Rome extended, they improvised entire cities, recalling by their general traits the aspect of the metropolis; and these cities became in turn so many centers whence Roman architecture radiated with Roman habits and customs. Thus all tended toward uniformity. Nowhere, however, did the art succeed in acclimating itself without losing some of the characteristics that had marked it at its origin; it was, on the contrary, divided into a series of schools, whose clearly distinct methods reflected by their diversity the infinite variety of local resources and traditions. I could, to show these differences, limit myself to instances of construction properly so called alone, but the shades of difference are still more clearly manifest when the forms of architecture are considered. Compare the monuments of Rome with those of Roman Egypt, and on one side will be found the architecture that is regarded as the official style of the empire; on the other, a collection of types and proportions so similar to as to be mistakable for the art of the time of the Ptolomies; it is known, for instance, that the porticoes of Denderah and Esneh do not date from before the Roman epoch.

In Greece, as well, the Romans conformed to the traditions of the ancient national art. The frontispiece, known as the Entrance to the Agora, is a curious monument of this Grecian school of the empire; a school, without doubt, degenerate, but still essentially Greek, whose works are rude imitations of the ancient Hellenic art, but which borrow nothing from the forms of the contemporary art of Rome.

If other examples of this local architecture which departs from the ordinary types of ancient architecture in Italy are desired, they can be found in the monuments raised in Central Syria during the first centuries of the Christian era. All the edifices of Hauran, in which an ingenious theory finds the origin of the French architecture of the middle ages, are much more like the monuments of France of the twelfth century, both in structure and decoration, than like the edifices of Rome, Egypt, or Athens; a new and striking manifestation of the national traditions that divided Roman art at all periods of its history.

The cities of the western coast and of the southern part of Italy, Pompeii among others, retained their Grecian physiognomy under the empire; in the territory of ancient Etruria, the national tradition gave the edifices, even those of after the conquest, the seal of masculine simplicity so strongly marked in the Roman ruins at Perugia.

We also had our architecture of the period of the Emperors;

[1] Here are some of them: —

1st. Prohibition against undertaking new buildings before finishing those already commenced.

Code Theod., Lib. XV., tit. I., l. 3, 11, 15, 16, 17, 21, 27, 29, 37.

Code Justin., Lib. VIII., tit. XII., l. 22.

2d. Prohibition against magistrates who have not themselves assumed the cost of public buildings, inscribing their names thereon in place of that of the prince.

Code Theod., Lib. XV., tit. I., l. 31.

Code Justin., Lib. VIII., tit. XII., l 10.

3d. Obligation imposed on magistrates who commence buildings of public utility without authorization from the prince, to assure the completion at their own expense.

Code Theod., Lib. XV., tit. I., l. 28, 31.

[2] Εις οικοδομιας δε πλειστας ανοφελεις τα δαμσια χραματα δαπανουν, τινα κατεσκευαςεν, α μικρον ὐστεραν διελυετω, βε βαιδ δια τᾶν επειζιν ον γενομενα (*Zos. hist.*, *Lib. II.*, cap. xxxii.).

and the characteristics of that elegant school of Gaul, evident in the ruins of St. Remy, of Orange and of St. Chamas, are such true expressions of the kind of genius that is properly our own, that they are rediscovered intact in the edifices of our Renaissance.

Thus it was that the forms of architecture differed in the different provinces. There was the same diversity in the practical methods; Vitruvius affirms this when, treating of the manner of building cut-stone walls (Lib. II., cap. 8), he makes a clear distinction between the customs of the Grecian and Roman builders. Independently of his testimony, however, sufficient proof of this can be found in the monuments themselves. Often, in fact, we have had to call attention to certain types of construction, and particularly to types of vaults, that were centered about such and such a country, where they were in a certain measure limited and perpetuated, without spreading abroad or ever reaching the character of general types; these are so many indications of the distinct traditions, of the local variations.

For example, the vaults of juxtaposed arches seem to have been special to a very limited region of which the aqueduct of Gardes is the center; in this country the unbonded vaults abound, — their use is to a certain degree the rule, — while elsewhere but a few isolated and imperfect examples can be found, and that with difficulty.

The same observation can be made of the system of ribs supporting horizontal slabs by means of tympanums. The only examples known to me belong in two provinces, both almost Greek — Southern Gaul and Syria; in Syria the importance of the system is comparable only to that of the pointed arches of the western buildings in the middle ages.

The hypogea of the north and center of France, whose style and stonework we have already characterized, are also monuments of a special form of construction. (Pl. XVIII. and XIX.) At their aspect one is struck by the originality of the conception that distinguishes them both from the other Roman monuments and from the works posterior to the barbaric invasions. The rampant vaults of echeloned arches, the barrel vaults centered on temporary walls, the use of the keyed groined vaults that the other schools sought to avoid, the evidently systematic use of stone of small size in a country rich in large material, are all unusual circumstances that place these monuments in a well-defined group, where are announced the tendencies of our medieval architecture, and whose memory or example had influence at the rebirth of French art at the end of the Roman period.

These few examples, all taken from monuments of cut stone, indicate, for the present, the nature and importance of the differences that separated the contemporary schools; if, to complete the review of ancient methods, we go back to our descriptions of concrete vaults, divergences of the same order, or even more strongly marked, will be found.

Even the network of brick, which was used with such skill and success in Rome that one is tempted to think it an essential element of the art of building, even these never came into general use. It expressed the spirit of Roman construction better than any other thing, but on the whole it amounted only to a local practice, and becomes rarer and rarer as one goes away from Rome. It is only necessary to go from Rome to Pompeii in order to see a notable change in this respect; the armature in the form of a network is replaced by degrees by a continuous thick layer of tufa, covering the centering and supporting the vault.

Toward the north, in Verona, we will find vaults with armatures like those of Pompeii, except that rounded pebbles replace the tufa used where the soil is entirely formed of volcanic debris. And when the Alps are crossed, even the idea of an armature disappears; or else, by a curious reversal of rôles, the armature of converging strata increases in importance to the point of becoming by itself the vault, while the masses of concrete in horizontal layers are no more than a covering, a backing, or, in a word, an accessory; the functions of the parts are inverted.

Such were, in a special division of the art of building, and in a restricted portion of the empire, the variety of aspects presented by the methods of construction. Looked at from a more general point of view, antique art offers this same diversity of aspects in all its branches. If the types of sculpture, of Roman ceramics, of provincial medals, or even of the mosaics found in different parts of the empire, are reviewed, everywhere the mark of local schools will be found with the same clearness; everywhere a certain base of common principles will show the impulse emanating from Rome. But every where, under this apparent uniformity, attentive examination will discover shades without number, or even contrasts, in accordance with the entirely distinct municipal life of the ancient cities. Each city had its own architectural traditions, as it had its civil institutions, its customs, and its cult. Roman art was essentially municipal; this was its first, its principal characteristic. Let us then think of it in its innumerable forms, not trying to lend it a fixedness of methods incompatible with the incessantly changing conventions and necessities. Transplanted to diverse soils, it was subjected to inevitable influences; it transformed itself in order to spread over all the regions of the empire; its methods were classed by species; its types were consecrated by time, and each colony, each municipality, had in its corporations of artisans, depositaries of the traditions of local practice; and, as we will see, the Roman respect for the customs and freedoms of these labor associations contributed to rendering the distinctions between the different schools sharper and more durable.

(*Continued.*)

FIRE-PROOF BUILDINGS.

A PROPOSED change in the building law of Boston which has occasioned some discussion is that which requires that apartment houses of four or more suites shall be of first-class construction — that is, shall be built, both in their exterior and interior, of non-combustible materials. The objection that has been raised to this is that it is pushing the fire-proof theory to an unwarrantable length; but, it may be that those who look upon the question from this standpoint do so in ignorance of certain important considerations. In the first place, the cost of fire-proof construction has undergone in the last few years an enormous contraction. Some of the best builders assert that the difference in cost between fire-proof construction and ordinary construction is no more than between 10 and 20 per cent., and with the passage of the tariff bill and the increase that has been made in building timber, it is not impossible that the cost of first-class construction will be little, if any, greater than that of ordinary construction. A fire-proof building thus constructed, when once put up, has a durability which is worth, on account of the saving in depreciation, all of the added expense. In the matter of insurance, a decided reduction in rates can be obtained, and owners and occupants can have a sense of security which insurance either against fire, life, or accident will not altogether give to them. A still further fact is that this form of construction is what is required in practically all of the cities and towns of continental Europe, with the exception, perhaps, of Russia. Not only is it necessary in these places to build apartment houses and other large structures in this way, but the ordinary dwelling house is a fire-proof building. The result of this general adoption of correct methods of construction is seen in the almost entire absence of large losses by fire. Thus, in Berlin, which is a city about the size of New York, there are each year about the same number of alarms of fire as in the latter metropolis, say, between 3,500 and 4,000, or ten alarms a day. But although New York has a large and wonderfully well-equipped fire department, and Berlin a relatively small and seemingly poorly equipped defensive service, the fire losses in Berlin are not much larger on the average than those met with in such cities as Lawrence or Haverhill, while the losses in New York city, where this thorough system of fire-proof construction does not obtain, is each year from twenty to thirty times as great as it is in Berlin. The time has come to make a step forward in construction, and hence we trust that the suggestion of the building commissioner in the matter referred to will be favorably considered by the Legislature.— *Boston Herald.*

Fire-proofing Department.

DETAILS OF FIRE-PROOF CONSTRUCTION WITH BURNED CLAY.

BY PETER B. WIGHT.

COLUMN PROTECTION.

THE work of the fire-proofing experts in connection with columns, pillars, or posts is confined to the protection of iron or steel, and forms no part of the construction of a building. An exception to this can be found in the first tier of seventy-two columns forming the arcade of the United States Pension Building, at Washington, which are built of drums of fire-brick, with a 5 in. hole in the center. Wooden posts are supposed to take care of themselves, which is largely the case where hard oak is used. When disasters by fire, caused by the breaking of iron columns, became frequent and noticeable, a great cry was raised by the underwriters, experts, and some professional firemen that nothing was safe in any building except a large wooden post which would not snap off or bend, but would stand as long as enough of it remained to carry its load. It was long before this time that other investigators had called attention to the danger of iron columns in a fire, and had suggested the proper remedy. The most prominent authority to demand the use of wood in superseding cast iron was the late Captain Shaw, of the London Fire Brigade, and what he said was taken up and echoed all through our own country. Yet, years before he published his first book, Wm. Stratford Hogg, an Englishman, had, in 1862, taken out a patent for protecting iron columns from fire by building circular bricks around them and leaving an air space between. But he received no encouragement, and there is no record of his patent having been used.

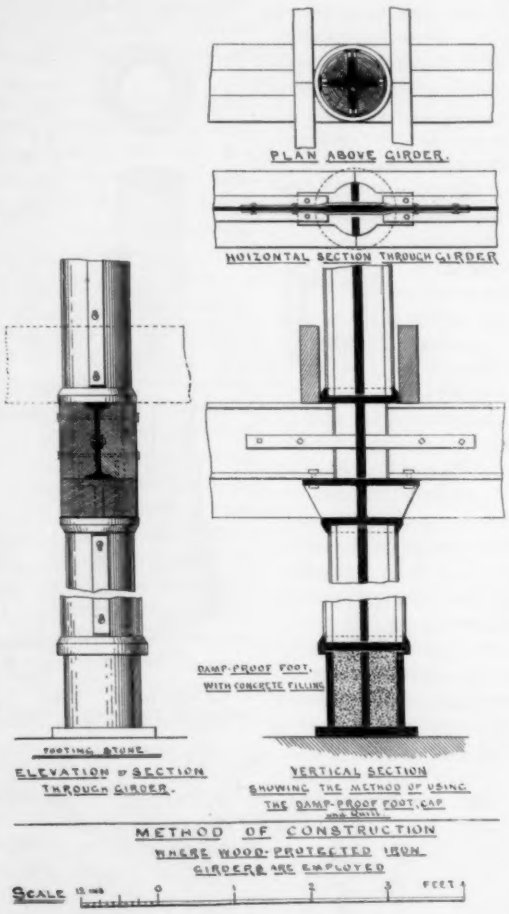


FIG. 1.

The result of this agitation was that in many buildings oak posts were used where it would have been better to employ iron protected by Hogg's method. This agitation led the writer to invent and patent, in 1873, a method of protecting cast iron by making the columns with four or more flanges, instead of in a cylindrical form, and securing gores of hard oak between them, depending upon the slow combustion of the surface of the wood, and its non-conducting properties when burning; for as a fact oak is a non-conductor of heat when one side is in combustion. The method was demonstrated by a comparative test with two unprotected iron columns in 1873. But while it attracted considerable attention, more on account of its novelty than its usefulness, the system was never put into use. It was not economical in the section of the iron used; yet no other form of casting could be employed that would admit of the application of the oak in a good form for protection. Fig. 1 shows how it was proposed to use this system, and its application to iron girders.

FIG. 2.

As porous terra-cotta was demonstrated to be a practicable article of manufacture in 1874, it was substituted for wood gores, and used for the first time with cast-iron cores of cruciform section in the Chicago Club, on Monroe Street, opposite the Palmer House in Chicago, now the Columbus Club. In these columns, of which there are four, the terra-cotta blocks project one inch beyond the flanges of the iron columns, and they are secured to the iron, not only by the cement, but by wrought-iron plates, 2½ ins. square countersunk into the tiles and screwed down to the edges of the flanges. The columns admitted of a plaster finish, and the ornamental capitals were of terra-cotta. Similar fire-proof columns were soon after used in the Milwaukee Board of Trade Building, some of which had six flanges in the iron cores. Five flange Phœnix wrought-iron columns were also used in the same building, and similarly fire-proofed.

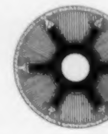


FIG. 3.

The next improvement in columns that were expected to finish twelve or more inches in diameter was to make the cast-iron cores in the form of a cylinder, with four or more projecting flanges of about 1½ ins. projection. This was found to require only a slight excess of metal over cylindrical castings of the same strength. The terra-cotta sections were made about 2½ ins. in thickness, and were secured to the iron by the same method as that used in the club house. These columns were used on a large scale in the retail store built by the late D. M. Ferry, on Woodward Avenue, Detroit, in 1879, and were used from that time up to about 1888, in such a large number of buildings that a computation then made showed that there were upwards of 40,000 lineal feet of columns thus fire-proofed. Fig. 2 is an illustration of one of these columns, and Fig. 3, a plan of one having six flanges as used in the First National Bank, Chicago. In 1884, this system came into extensive use as an application to the Phœnix wrought-iron columns. These are the same in practical shape as the cast-iron cores that had been used. Instead of screwing the countersunk plates into the edges of the flanges, cast plates were made with two hooks, which would fit over the rivet heads in any part. As the blocks were built up in place, a course of plates was hooked onto the rivet heads at about every two feet in height, and then built in with the next course of blocks. In this way all the Phœnix columns of the Mutual Life Insurance Building, on Nassau Street, in New York, were covered, most of them being six-flange columns. Fig. 4 is an illustration of the usual method applied to Phœnix columns, and Fig. 5 shows a special method applied to two columns in the Chicago Board of Trade. It was not uncommon, also,

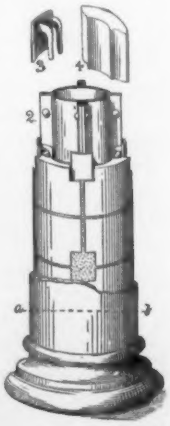


FIG. 4.

where it was desired to give square cast-iron posts a round finish, to make the blocks flat on the inside, and curved on the outside for this purpose. The countersunk plates were secured by screws to the outer angles of the castings, using them as if they were flanges. In the same way square cores were covered to finish square with chamfered angles (see Fig. 6), and even round columns were covered with porous terra-cotta blocks, so as to make them finish in a square form. For this purpose, and for the fire-proofing of cylindrical cast-iron cores that were not provided with vertical flanges, the castings were tapped with holes into which small, round studs were screwed, and the countersunk plates used to secure the fire-proof blocks were screwed into these studs (see Fig. 7).

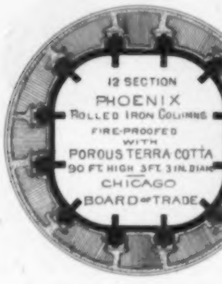


FIG. 5.

This system was based on the idea that no fire-proof material can be depended upon to hold itself in position, and that cement is only subsidiary to mechanical fastenings. It did not allow any fire-proof covering of an iron column to bulge off by vertical expansion, because it depended upon the individual fastening of the porous terra-cotta blocks to the iron core. This proved to be effective in every case in which it was tested. When the Grannis Block was burned in Chicago no attempt had been made to make it fire-proof in any particular, except that the cast-iron columns were covered as here described. But columns that had fallen down in the ruins were taken out with all their fire-proofing attached.

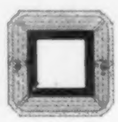


FIG. 6.

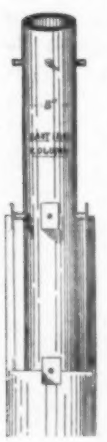


FIG. 7.

The engineers attached to the office of the supervising architect of the Treasury Department decided to fire-proof the columns of all buildings between 1880 and 1890. But they refused to allow them to be cast with flanges, and only allowed about 1½ ins. of thickness for the terra-cotta fire-proofing. As they would not permit the columns to be drilled, the fire-proofing had to be secured with bands. To put these on the outside, or to wire the blocks on, which the specifications allowed, would have exposed these fastenings to fire. Those which were done by the Wight Fire-proofing Company were covered with blocks having grooved edges. As each course was set, a hoop of iron was bent around the column, hooked together at the ends, and dropped into this groove. Then the next course was set with the grooved edge down, and thus the iron bands were incorporated with the tiles and cement, and protected from heat on the exterior. In this way the cast-iron columns of at least thirty government buildings were fire-proofed. Fig. 8 is an illustration of the method, and Fig. 9 a plan of one of these columns.

This is somewhat like writing up ancient history; for every one of the processes above mentioned has been out of use for from six to nine years. It is perhaps needless to add that they are the methods used for a long time by the company of which the writer was the originator, and which went out of business six years ago. The reasons for this are two. They are such as are not called for in the specifications, and sometimes more expensive than those in present use. It is part of its history that the Wight Fire-proofing Company, in the later years of its existence, followed in many cases the methods of its rivals in covering iron columns, for the simple reason that these were all

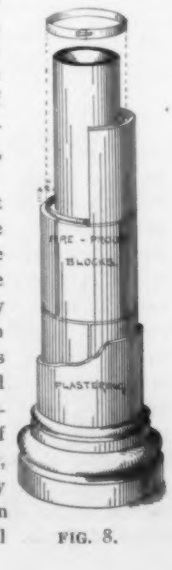


FIG. 8.

that were called for and demanded in architects' specifications, or paid for by the owners. This was even the case in some of the largest government buildings. What seemed to become the standard system of fire-proofing columns at that time consisted of a flangeless unglazed hard drain tile, scored in two places so that it would split in two, and then set up around the column so as to break joints. In some cases the architect or superintendent would demand that they be tied on with wires, which was generally done when it was ordered, because it cost next to nothing, and it was not worth while to kick. An illustration of one of these is here given. (Fig. 10.) In other cases it has been customary to cover Z bar, or other kinds of built steel columns, with hollow blocks of hard, hollow tile, built as a wall around them and without fastenings, as was the case in the Horne Department Store at Pittsburgh, recently burned, and described in the June BRICKBUILDER. A few architects have required that the Z bar columns shall have their hollows filled in with pieces of tile before the exterior covering is put on. In other words, they think that the hollow tile covering is better when it is *stuck on* as well as built up. Such are the methods now generally used where tiles are employed, and hard or porous tiles are used indifferently according to whether the lowest bidder is a "hard" or "porous" manufacturer.

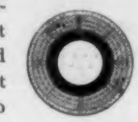


FIG. 9.

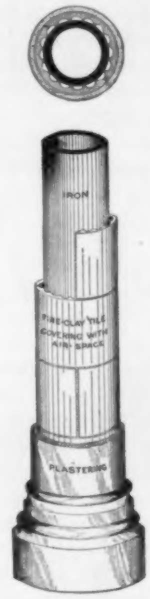


FIG. 10.

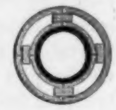


FIG. 11.

There is some food for reflection after reading the opinions of some of the most successful architects of New York and Boston, on the general character of our fire-proofing, in THE BRICKBUILDER for January and February. In the course of all of those interviews, which are characterized by very just criticisms of many of the shortcomings of the makers and users of clay fire-proofing materials, no suggestion was made of the necessity of *securing* the fire-proofing to the iron or steel by mechanical means. Those who referred to column fire-proofing only suggested increasing its thickness, and one said that it should be "at least" 4 ins. in thickness. Another suggested filling the columns solid with cement on the inside, and putting metal lathing and plastering on the outside. Mr. Carrère showed the most perfect knowledge of the defects and necessities of the fire-proofing art as practised in Eastern cities; but his only suggestions about column covering were that they should be heavier, interlocking, or that they should be doubled. The building law of Chicago, which was last amended so that it should cover also the use of plastic coverings with metal lathing, requires that there shall be two air spaces around all columns. THE BRICKBUILDER has already pointed out that the defective method, as in the Horne Department Store at Pittsburgh, which *by some good chance* left the columns intact though it fell off promiscuously, is admissible under its provisions.

So we find that in the present state of the art neither the laws nor the practise of the leading architects, nor the methods advertised by manufacturers or contractors,[1]

FIG. 12.

[1] The writer has looked in vain through the published catalogues of the present manufacturers of fire-proofing materials of clay for illustrations, or descriptions of methods for protecting iron or steel columns from fire, which provide for fastening the protection to the column, with the earnest hope to be able to do them justice, but has found none. Most of the illustrations given in them are unauthorized copies of some of the shapes that have been described in this paper, without the fastenings. Of those

are calculated to insure the safety of this most vulnerable feature of modern fire-proof buildings. We have traced a brief outline of the art as it has been practised,—necessarily brief, for very much more could be said on the subject. It does not show that the case is hopeless. It only demonstrates that we have much to learn that seems to have been forgotten. To sum up, it must be recognized that some method is better than others, and the best should be used. It is an unfortunate fact that the element of cheapness has been the main cause of depreciation, no less than the indifference of the architects. This is not to say that the effective fire-proofing of columns is a very expensive operation. On the contrary, there is very little difference in cost between good methods and bad ones, and this difference would hardly be noticed in the aggregate cost of a large and expensively finished fire-proof building, if attention is given to this detail at the proper time.

FIG. 13.

The writer was led into the field of fire-proof construction by his study of the best methods for protecting iron columns from fire. His first and every effort was to avoid any unnecessary additions to the diameters of columns. We have now become accustomed to these additions, and architects even propose to increase them. He found that porous terra-cotta was the best material for the purpose, because, on account of its own non-conducting properties, it did not require a hollow space. He also found by experiment and practise that a thickness of 2½ ins. of this material was sufficient under any circumstances, and that wherever it could be used it need not project beyond any flange more than 1 in. He became convinced that any fire-proofing material was liable to be forced away from the column by its own *lateral expansion in the direction of the length of the column*, and that it must be fastened directly to the column by mechanical means, countersunk for their own protection. These are the fundamental conditions of column fire-proofing, no matter how applied. They make it possible to save much space and yet get the best results. They are applicable to every form of vertical support now in use, and in applying them the best fire-proofing material ever made, porous terra-cotta, should always be used. The use of porous, and not semi-porous, material is recommended for inert or protecting material when used solid, while the semi-porous terra-cotta is recommended when used in the hollow form.

FIG. 14.

In making these suggestions much has been said that looks like advertising, and it must be added by way of explanation that all patents covering these methods have expired, and there is no monopoly of these ideas. THE BRICKBUILDER in publishing them is only doing missionary work in a cause which it is endeavoring to serve. We do not claim to be infallible, nor is the admission that there is always room for improvement a confession of the weakness of a cause. In this case it shows that the use of clay in the erection of fire-proof buildings is always capable of a higher development in the hands of those who are seeking for the best results.

OF all known fire-proofing materials, it has been unquestionably proven that burnt clay is the most effective for the prevention of the spread of fire. Where it has shown failure, faulty methods of application have been the cause. This is a matter that we may expect to see satisfactorily handled in the near future, as never before has it received the intelligent study that is being given it at present.

that appear to have merit and originality, the illustrations Figs. 11 and 12 show a plan and general view of one method of the Pioneer Fire-proof Construction Company, of Chicago, in which hollow tiles are held together *around* the column with cramps. Fig. 13 shows the method of the Illinois Terra-Cotta Lumber Company for protecting the Lorimer steel columns, and Fig. 14 shows the same method for cast-iron cylindrical columns. There is no description of these, but it has been noticed in practise that the blocks are built in courses breaking joints. Nearly every maker in the country makes for the Z bar columns either the ordinary partition tiles or hollow blocks similar to those used in the Horne Department Store and illustrated in BRICKBUILDER for June.

Mortar and Concrete.

LIME, HYDRAULIC CEMENT, MORTAR, AND CONCRETE. V.

BY CLIFFORD RICHARDSON.

THE MANUFACTURE OF NATURAL CEMENT.

FROM the preceding pages it is apparent that in the establishment of the natural cement industry at any point, a thorough study of the chemical composition and physical properties of the available rocks is necessary, in order to determine upon the selection of suitable material for the purpose and the rejection of that which is unsatisfactory. The proper manner of mixing and burning strata of different composition must be decided upon, and the economic considerations affecting the quarrying of different strata, depending on their dip and overburden, must, of course, not be neglected.

The following are the most important points to be considered in connection with the examination of hydraulic limestones:—

CHARACTER OF THE ROCK. The general appearance and nature of the various strata in any quarry of cement rock, their color, grain, and hardness, are usually somewhat different, and sufficient to distinguish and identify them. An examination in the laboratory, even with limited facilities, will then reveal definite physical and chemical properties which will enable one to determine the availability of the stone for the manufacture of cement.

PHYSICAL PROPERTIES. It is of the first importance that the rock should be dense. A light rock will not burn well or grind to a cement of suitable volume, weight, or density. The specific gravity determined at 78 degs. Fahr. should not be below 2.70, and should preferably be 2.8 or higher. Some hydraulic limestones have a specific gravity of only 2.65, and are inferior, while, where weathering has taken place, it may be even less. The best rock is always obtained after a quarry has been so far worked as to have reached beyond all weathered material and alteration products. Where the dip is sharp, this condition is soon arrived at; but when there is little dip, all strata must be rejected which are near enough the surface to have been weathered or acted upon by water.

In the Rosendale series of cement rocks the following densities at 78 degs. Fahr. were found for stone, all from deep levels, but at different depths.

Nearest Surface.		
	Light rock,	2.830
	Dark rock,	2.849
Medium.		
	Light rock,	2.815
	Dark rock,	2.841
Deepest.		
	Light rock,	2.827
	Dark rock,	2.845

At these depths below ground there is little difference in the density of the rocks obtained, all being very heavy and typical of the best quality.

The Fort Scott, Kansas, rock, on the other hand, which is nearer the surface, has a density of only 2.730; that at Round Top, Maryland, 2.731; while that of the hydraulic limestone of Illinois is no greater than 2.667, and of course does not produce as dense a cement.

The state of aggregation is as important as the density of a cement rock. The mixture of clay, sand, and carbonates should be

thorough, and one in which the constituents were deposited in the form of an impalpable powder. Where the sand is coarse, the clay in lumps, or the carbonates in pockets without admixture of silicates, the rock is unsuited for cement burning. Mere inspection will usually reveal the uniformity of the rock, while the size of the particles can be determined by dissolving a weighed fragment, without pulverizing, in acid, and determining the size and amount of the insoluble particles of sand remaining undissolved by means of fine sieves. As an example may be mentioned a magnesian limestone from a Virginia cement quarry, which might have made a fair cement were it not for the coarse nature of the stone. The residue of clay and sand, insoluble in acid, consisted of 9.5 per cent. of particles too large to pass an ordinary 100 mesh cement sieve. It was, therefore, necessary to reject this stratum in working the quarry.

In the Rosendale rocks the following residues were found in the cement rocks at various levels: —

		Per cent. of Residue on Sieve.		
Nearest Surface.		200 mesh.	100 mesh.	50 mesh.
	Light rock,	2.9		
	Dark rock,	0.0		
Medium.				
	Light rock,	0.0		
	Dark rock,	0.0		
Deepest.				
	Light rock,	0.6	0.6	0.4
	Dark rock,	1.2	0.5	0.3

On treatment with acids these rocks retained their original shape, but could then be broken down by a rubber pestle or the fingers, revealing, in one case, some firm silicious veins which were quite resistent. Under the microscope the fine residue has the appearance of kaolin.

Where it is necessary to use a coarse rock, the burning must be slow and prolonged, in order to bring about as much combination between the lime and silica as possible; otherwise, the finished product is merely one of quicklime and but partially combined silicates.

CHEMICAL COMPOSITIONS.

CARBONATES OF LIME AND MAGNESIA. The amount of carbonates in a hydraulic limestone cannot exceed 75 per cent. and produce a good cement, and, in most cases, they should preferably be less than 70 per cent. Where several strata are taken from one quarry it is possible to use a small proportion of rock richer in carbonates, but this is undesirable on account of the difficulty of properly burning the richer limestone. The average composition of a mixture of rocks under such circumstances cannot exceed 70 per cent. without the production of an inferior or hot cement. With 75 per cent. of carbonate of lime the proportion for Portland cement is reached, and a different system of burning is necessary. The material from which Portland cement is made will, however, give a rock cement when lightly burned, but one that is very quick setting.

Hydraulic limestones, which are free from magnesia, probably make the best cements when properly proportioned. They must, however, contain sufficient clay. Such a stone has the composition given for the No. 2 rock of the Maryland quarry where the total carbonates are 68.44 per cent., including only 4.58 per cent. of carbonate of magnesia, while the silica and clay amount to 29.66 per cent. Rock of this description is rarely found. Where the latter constituents are deficient cement from such a rock is very quick and hot, especially when the rock contains more silicious sand than clay.

MAGNESIA. As has been already shown, the majority of the hydraulic limestones in use in the United States are magnesian, the amount of magnesian carbonate varying from 39 per cent. to little enough for the stone to be considered as a straight lime rock. In any single rock or mixture the carbonate of magnesia should not exceed 30 per cent., and should be preferably not more than 25. From a stone with more than the latter, the cement produced has a tendency to expand slowly with age, especially when deficient in clay. This is illustrated by a Western New York rock, having 37.0 per cent. of magnesian carbonate, and less than 11 per cent. of silica and silicates, which yields a cement which expands in concrete to a very large degree for many months or even years after use.

The Rosendale cements, owing to their density and composition, are the highest type of this class of cements. The rock they are made from contains only about 20 per cent. of magnesian carbonate, with 30 per cent. of clay.

SILICA AND SILICATES. The amount of silica and silicates in hydraulic limestones is, of course, inversely proportional to that of the carbonates they contain. When rich in carbonates they are poor in silica and silicates, and the reverse. As it is to the presence of these substances that the limestones owe their hydraulic properties, the amount which they contain is of the greatest importance. It is also of quite as much importance that the silica should be largely, if not entirely, in combination with alumina as clay, and not in the free state as mere sand. This is determined by the amount of alumina and iron in the stone, which serves as an index of the possible clay present. For example, in a stone from Akron, N. Y., and one of the Rosendale series, the analyses previously given show 35 and 29 per cent. of substance insoluble in acid; but an examination of the amount of alumina and iron present reveals the fact that there can be but little clay in the Akron stone, while there is an abundance in the Rosendale, one having only 4.84 per cent. of alumina and iron while the other has 10 per cent. The Rosendale rock, in consequence, makes a very superior cement, while the Akron shows the peculiarities of a cement deficient in clay and too rich in magnesia. In fact, a deficiency in clay is more serious in a magnesian than in a lime cement, as under such circumstances there is very apt to be serious expansion of the cement after use.

Cement rock deficient in clay yields cements which heat and set too quickly. On the other hand, too much clay in a hydraulic limestone is as bad as too little. Cement made from such rock will blow or expand, when immersed in water, especially when carelessly burned. Clay may also contain too much iron oxide and insufficient alumina, in this case yielding a weak cement.

SULPHATES AND SULPHUR. Sulphur occurs in limestone as sulphate of lime and as pyrites or iron sulphide. These substances are rarely present in sufficient amount to affect the quality of cements. Sulphates are sometimes reduced in burning, combining with some of the iron oxide to produce the green color now and then seen in briquettes of natural cement. Two per cent. of sulphur in its compounds is a large amount for a cement rock to hold.

ALKALIES. Potash and soda are sometimes found to a considerable amount, between 1 and 2 per cent., in the silicates of hydraulic limestones. Unless they are present in more than the usual traces they have no effect on the cement. In excess they make the rock fusible in the kiln, in consequence of which such material is rejected or must be burned slowly at low temperatures. As far as is known, they do not injure the quality of the cement. The amount present in various well-known cements is as follows: —

ALKALIES IN HYDRAULIC CEMENTS.

Milwaukee	Cement,	K_2O	.87%
"	"	Na_2O	1.64
Ft. Scott	"	K_2O	.70
"	"	Na_2O	1.33
Akron, Star	"	K_2O	1.39
" "	"	Na_2O	.23
Akron, Obelisk	"	K_2O	1.60
" "	"	Na_2O	.52

Buffalo	Cement.	K_2O	1.44
"	"	Na_2O	.41
Rosendale	"	K_2O	
"	"	Na_2O	
Round Top	"	K_2O	
" "	"	Na_2O	

It will be noticed that in some cases potash is in excess, in others soda. This is due to the kind of feldspar from which the clay in the cement rock originated.

MINOR CONSTITUENTS. All limestones contain small portions, fractions of a per cent., of other elements besides those mentioned, such as barium, strontium, manganese, phosphoric acid, chlorine, and other widely diffused substances, but they have little or no influence on the suitability of the rocks for cement making, and may be neglected unless their amount is more than a trace.

CRUDE TESTS OF ROCK.

Where it is impossible to obtain complete chemical analyses and determinations of the physical properties, such as have been mentioned, a fair idea of the peculiarities and deficiencies of any hydraulic limestone may be obtained to supplement burning tests in the experimental kiln, or muffle, from an estimation of the loss on ignition. This corresponds to the amount of carbonates, and inversely to the per cent. of substances, insoluble in acid, present. From such a determination, especially when the appearance of the residue is examined critically with the object of learning its character, an approximate conclusion can be drawn as to the value of a stone or the cause of its inferiority.

In the simplest way an ordinary coal fire, in which pieces of the rock are buried and burned for varying lengths of time, will furnish much valuable information.

APPLICATION OF THE RESULTS OF ANALYSES TO PRACTISE.

As illustrations of the application of the information obtained from the physical and chemical examination of cement rocks to their selection and use in cement making the following cases in actual practise will serve.

QUARRY OF MAGNESIAN HYDRAULIC LIMESTONE.

Some years ago a new quarry of magnesian cement rock was opened in Maryland, which contained a large number of distinct strata which were available for making cement. I was requested, with due consideration for economical working, to select, after a chemical and physical examination, the best strata for use in making a high-grade natural cement.

The strata which were submitted were eleven in number, mostly of light color, and all, with one exception, quite uniform in character, but readily distinguished by their appearance. The results of the laboratory examination were as follows: —

ANALYSES OF MAGNESIUM LIMESTONE, MARYLAND CEMENT COMPANY.

No.	1	2	3	4	5	6
Loss on ignition	36.56	29.50	41.95	34.82	31.09	39.65
Silica	14.61	23.99	6.68	15.97	21.45	9.89
Alumina and Iron Insol.	3.83	5.60	2.03	4.54	4.01	2.77
" " " Sol.	2.49	4.17	1.58	3.05	2.86	2.73
Lime	25.25	20.16	31.59	23.72	23.87	28.63
Magnesia	16.18	13.33	15.81	15.64	12.98	15.15
Sulphur as SO_3	.78	1.29	trace	.71	.22	.34
Calcium carbonate	45.09	36.01	56.42	42.36	42.63	51.13
Magnesium carbonate	33.98	27.99	33.20	32.84	27.26	31.82
Total	79.07	64.00	89.62	75.20	69.89	82.05
	Poor		Bad	Poor		Bad
Silica, etc., coarser than 100 mesh screen	9.51	6.92	1.29	.04	.00	4.84

	7	8	9 Light	9 Dark	10	11
Loss on ignition	28.55	33.23	37.34	39.64	30.94	38.95
Silica	33.06	20.47	15.01	9.06	19.70	8.01
Alumina and Iron Insol.	3.26	5.09	3.22	4.84	4.84	2.63
" " " Sol.	3.26	2.67	5.22	2.51	5.09	1.59
Lime	20.33	26.20	25.85	27.88	20.25	39.77
Magnesia	10.26	11.59	18.84	15.67	15.23	7.43
Sulphur as SO_3	.82	.58	trace	.38	.34	.44
Calcium carbonate	36.31	46.79	46.17	49.79	36.16	71.03
Magnesium carbonate	21.55	24.34	39.56	32.91	31.98	15.60
Total	57.86	71.13	85.73	82.70	68.14	86.63
Silica, etc., coarser than 100 mesh screen	.32	1.31	.32	.00	2.02	.33

The rocks of the different strata in this quarry are distinguished in a general way by the rather low percentage of alumina and iron, and consequently of clay. The insoluble portion in many cases is largely silica, and rather coarse grained, as may be seen from the determinations of its size.

Stratum No. 1 was recommended for rejection, as it contained 9.5 per cent. of sand coarser than would pass the ordinary screen of 100 meshes to the inch. This rock was also too rich in carbonates, and would have given, under the best handling, an inferior cement, as magnesian cements deficient in clay are not constant in volume after use.

Stratum No. 2 had an excellent chemical composition but physically was too coarse, and, lying among inferior strata, it would naturally be neglected for economical reasons.

Stratum No. 3 was rejected because quite deficient in clay and silica.

Stratum No. 4 was characterized as a poor rock which might be used if necessary, but was not recommended, being deficient in clay.

Stratum No. 5 was marked as being a slight improvement over No. 4 owing to the smaller amount of carbonates it contained, although deficient in clay.

Stratum No. 6 was too rich in carbonates and too low in alumina or clay to be used for hydraulic cement.

Stratum No. 7 proved the most silicious of the series, although it contained little clay. With care in burning it could be used, as the silica was present in a state of fine division. It is, however, not an entirely satisfactory rock.

Stratum No. 8 proved a good stone for this quarry.

Stratum No. 9, in both its forms, light and dark, was, besides having great lack of uniformity, too rich in carbonates and deficient in insoluble matter. By itself this stratum would prove a poor one.

Stratum No. 10 was an excellent one, and was recommended for use.

Stratum No. 11 appeared at a glance to be insufficiently hydraulic, and was excluded.

Of all these strata, for one or more reasons, only those numbered 5, 8, and 10 were considered to be fairly good rock, if burned by themselves. The possibility, however, of mixing the cement made from the different strata permits the faults of one to correct those of another to a certain extent. The stratum No. 7 was, therefore, included, and such a mixture served very well. Cement so prepared analyzed as follows: —

Loss on ignition	8.29
Uncombined silica	16.30
Silica combined	13.50
Alumina and iron oxide	11.04
Lime	33.36
Magnesia	15.58
Sulphuric acid	.40
Alkalies	1.50

The proportions of silica, clay, and carbonates are satisfactory in this mixture, and gave a good cement which, it would seem, might perhaps have been improved by some further slow burning, as too much of the silica was in the uncombined form. As a matter of fact, however, rock from this quarry in practise had to be burned lightly

and with great care to obtain the best results, and for this reason considerable silica was left uncombined. The cement has proved, after long use, to be a satisfactory and permanent one, although probably not one of the best.

QUARRY OF MAGNESIAN FREE CEMENT ROCK.

In another Maryland quarry, where the rock was as nearly free from magnesian carbonate as ever happens, an opportunity occurred for a study of the variations in composition of a large number of strata, and of the suitability of this kind of hydraulic limestone for cement making. The strata had a dip of nearly 90 degs., and, being exposed along the face of a high cliff, were, in consequence, very accessible.

The rocks, fifteen in number, had the following composition and furnished, when burned by themselves, experimental cements which set and tested as given.

COMPOSITION OF THE STRATA OF ROCK AND TESTS OF THE CEMENT BURNED THEREFROM IN A MARYLAND QUARRY, MAY–JUNE, 1892.

No.	1	2	3	4	5
Silica	28.08	20.40	28.72	26.36	16.38
Alumina	12.58	12.42	12.28	10.88	8.42
Iron	5.00	4.86	5.22	5.50	2.86
Calcium carbonate	45.86	57.93	43.82	48.75	62.56
Magnesium carbonate	2.18	2.98	2.31	2.85	5.76
Total carbonate	46.04	60.91	46.13	51.60	68.32
Total aluminum and iron oxide	17.58	17.28	17.50	16.38	11.28
Sulphur	.00	1.18	1.53	1.73	.67
Total silica and silicates	45.66	44.68	46.22	37.24	27.66
Set initial	30 ft.	10 ft.	65 ft.	7 ft.	26 ft.
Tensile strength.					
1 day neat	36	83	64	60	64
7 „ „	64	212	252	190	218
28 „ „	152	275	252	276	307
3 months.					
7 days 2 parts quartz	46	122	184	168	127
28 „	110	250	210	206	233
	6	7	8	9	10
Silica	21.94	9.92	12.12	21.78	29.22
Alumina	7.96	3.38	2.36	5.57	11.48
Iron oxide	3.78	2.22	3.78	3.82	3.52
Calcium carbonate	60.75	81.52	51.82	61.40	44.57
Magnesium carbonate	2.01	1.07	23.39	3.15	3.86
Total carbonate	62.76	83.49	75.21	64.55	48.43
Alumina and iron oxide	11.74	5.60	6.14	9.39	15.00
Sulphur	.34	.11	.00	1.10	.78
Total silica and silicates	33.68	15.52	18.26	31.17	44.22
Set initial	32 ft.			48 ft.	14 ft.
Tensile strength.					
1 day neat	61			48	54
7 „ „	218			220	225
28 „ „	210			262	220
3 months.					
7 days, 2 parts quartz	152			187	165
28 „	240			239	268
No.	11	12	13	14	15
Silica	16.82	18.50	35.38	8.78	42.94
Alumina	5.46	6.34	13.46	2.70	12.62
Iron	3.66	4.28	4.28	2.62	5.92
Calcium carbonate	69.54	43.03	33.61	80.39	25.56
Magnesium carbonate	2.69	16.00	7.56	4.02	8.35
Total carbonate	72.23	59.03	41.17	84.41	33.91
Total aluminum and iron oxide	9.12	10.62	17.74	5.32	18.54
Sulphur	.80	.35	.82	.64	.17
Total silica and silicates	25.94	39.12	53.12	14.10	61.48
Set initial	4 ft.	14 ft.			

Tensile strength.		
1 day neat	128	62
7 „ „	250	138
28 „ „	266	300
7 days, 2 parts quartz	233	80
28 „	285	190

These hydraulic limestones are very typical of cement rock which is free from magnesia. They show quite as marked variations in composition as those of any quarry that has been examined, having from 84 to 34 per cent. of carbonates containing from 23 to 2 per cent. of carbonate of magnesia, with from 61 to 14 per cent. of silica, alumina, and iron oxide, and from 1.73 to 0 per cent. of sulphur as sulphates. Physically the rocks were of very fine texture, as only one, No. 5, left particles too coarse to pass a sieve of 100 meshes to the linear inch on solution in acid, in this respect being very different from those of the magnesian quarry previously described. Of all the rocks it is at once evident that Nos. 7, 8, 13, 14, and 15 must be rejected, 7, 8, and 14 on account of their excess of carbonates and deficiency in clay, and Nos. 13 and 15 for the opposite reason. Stratum No. 8 would, however, furnish a cement of the Western New York class.

Of the other strata, cements were burned in an experimental kiln and tested, with the results given. The remarkable fact that good, natural hydraulic cement could be made from rock of such very varied composition is very striking.

The group of strata 1, 2, 3, and 4 are all very high in alumina and iron, consequently of clay. Nos. 2 and 4 are in addition the highest of these in lime, and consequently yield the quickest setting cements. No. 3, having the least lime, is the slowest setting. With the high percentage of clay which these limestones hold their burning must be conducted carefully, or blowing cement would result.

Strata 5, 6, and 9 are lower in clay and higher in lime than those preceding, and furnish slower and more satisfactory cements. No. 10 resembles the highly clayed rocks 1 to 4. No. 11 is so rich in lime and poor in clay as to make a fiery cement, and No. 13 is, as we have mentioned, rejected on account of its magnesia.

We found, then, in this quarry two particular classes of rock, one highly clayed, the other much less so. This fact and the economy of working the strata led to the decision to burn the strata 2, 3, and 4, as one lead in the quarry, in one set of kilns, and numbers 9 and 11 as another lead in another set of kilns, mixing the burned rock before grinding. If an increased output was desired, it was suggested that Nos. 5 and 6 be added in the second series, or No. 12 omitted and these used in its place.

With these suggestions as a guide the works were established, and a high-grade cement made after some experimenting as to the best manner of burning.

The physical properties of the cements made from the different rocks of this quarry are instructive. The high lime and low-clayed rock, No. 11, made a cement which gave the greatest immediate returns, both in quickness of set and in tensile strength, of any of the strata. It must be noticed, however, that, having acquired this strength quickly, there was little or no increase at a later period. This is very characteristic of such cement.

The magnesia rock, No. 12, gained in strength slowly, as all magnesia cements do, but would in the end have probably exceeded many of the others. As it was, it surpassed in neat strength all but one at 28 days. If used for the manufacture of cement, it would probably have to be burned in a different way from the other strata, to obtain the best results.

Strata Nos. 1 and 4, which are nearly identical in composition, yielded cement of quite different quality, No. 1 being the weakest of all that were burned. This can only be attributed to a difference in the manner of burning. It is probable that No. 1 was either under or overburned.

The cements from the other strata were much alike in tensile strength.

The Masons' Department.

STRAINS IN ARCHES. III.

BY JOSEPH MARSHALL.

IF we now apply to the method pointed out in the foregoing chapters the test of the "resolution of forces," we will have a fair comparison, and may judge whether the foregoing methods are sufficiently approximate in their results to be considered worthy of adoption in practise.

Referring to Fig. 10, which is drawn to a scale of ⅛ in. to the foot (reduced one half in reproduction), we have the heavy line B to a indicating the pier supporting an arch indicated by the heavy lined arc a to v, which is intersected at c' by the neutral line o n drawn at 45 degs. elevation.

Assuming that the arch is 1 ft. by 1 ft. sectional area, and that the weight of that part of the arch above the neutral line is (in even hundreds) 2,000 lbs., and that part below the neutral line also 2,000 lbs., we have the diagonal line $c'v$ indicating a force of 2,000 lbs. in the direction towards c'. Resolving this into two equivalent forces,— one acting horizontally, the other vertically,— we have the parallelogram c' H v w, which in their magnitude and direction are equal to c' v. If c' w with its indicated force acted from c' towards w, and c' H also with its indicated force acted towards H, they would conjointly exactly balance the 2,000 lbs. indicated of c' v.

Then for the force and direction of the lower part of the arch we have the parallelogram c' a' a l with the diagonal l a' indicating a magnitude of 2,000 lbs. force, with its equivalents l a vertically and l c' horizontally. The forces indicated by the horizontal lines l c' and c' H act in opposite directions and in the same straight line, and, therefore, are to each other as the algebraical differences of their magnitudes. If they were of equal magnitude they would exactly balance each other. But they are not equal in magnitude, and hence one must be greater than the other — c' H, indicating the thrust, is the greater, and l c', indicating the counterthrust, the lesser. Beyond establishing the relations and magnitude of the forces in the arch the employment of the parallelogram of force is useless, because the excess of force, whatever it may be or in whatever direction acting, acts upon the pier at l and in manner to convert the pier into a lever of the length l B. Having discovered the difference in magnitude between the thrust and counterthrust, and knowing the length of the lever l B, nothing remains but to proceed with the numerical calculation as in Chapter II. The diagonal line c' v being charged with representing 2,000 lbs. force, and choosing the scale of one eighth of an inch for 125 lbs. (convenience dictating),

we have c' to H equal to	14¾	eighths, and
from l to c' equal to	6¼	eighths.
Subtracting, we have	8½	eighths thrust
× 125 lbs. to each eighth	125	
Gives excess of thrust at l	1062½ lbs.	
× by length in feet of lever l B	44¾	
Excess of thrust force at B	47547 lbs.	
This must be counterpoised by:		
÷ weight of half arch	4000 lbs.	
plus weight of pier, 30 ft. by 121¼ lbs. weight per cubic feet	3637	
Total counterpoise weight in pounds	7637)45822(6 ft.	
	1725	
	×12 for ins.	
	20700 (2 ins.	
	15274	
	5426 / 7637 = ¾ nearly.	

Or 6 ft. 2¾ ins., nearly, for the length of the bent arm of the lever from B towards x. In our numerical calculation in Chapter II. we found the requirement at this point to be 6 ft. 4½ ins., or 1¾ ins. more than by the present calculation.

It is now expedient that we inquire into the necessary length of the lever arm at a, the springing line of the arch.

We have, of course, the same excess of thrust force indicated above, but the counterpoise weight is reduced to the weight of the half arch only, and the length of lever is only from l to a, 14¾ ft.

Hence we have: —

Excess of thrust at l	1062½ lbs.
× length of lever l to a in feet	14¾ ft.
Thrust force at a (omitting notice of fraction)	15672 lbs.
÷ weight of half arch in pounds	4000) 12000 (3 ft.
	3672
	× 12 for ins.
	44064 (11 ins.
	44000

or the bent arm of the lever l a extending towards b is shown to be required to be 3 ft. 11 ins.,— the fraction is worthless.

In numerical calculation in Chapter II., this arm is shown to be 4 ft. 3¾ ins.; there is then a difference between the two results of 1¾ ins. for the arch when mounted on piers 30 ft. high, and 9¼ ins. when the arch rests on its springing. The question will at once arise why this difference — even small as it is—why does it appear?

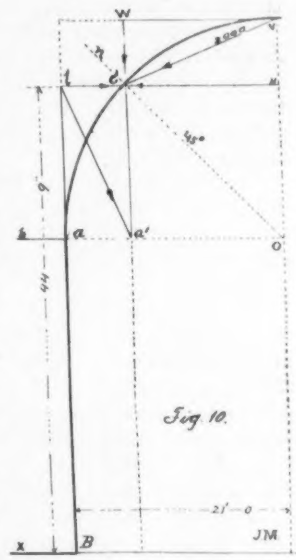


Fig. 10.

In answer we will say that in the method shown by Chapter II., the fixing of the length of the lever through which the counterthrust force operates is somewhat arbitrary, as is also the counterthrust force itself. But, although arbitrary, convenience is served by it and the degree of accuracy quite sufficient for practical use. Limited space herein forbids more extensive explanation and observations upon this very important subject,— conditions which may in the future be otherwise removed, — but it is necessary here to observe, as a cautionary advice, that the dimensions of pier required to support a given arch are not safely ascertained by drawing a straight from the indicated requirement at the nether base of the pier, as at x, to the indicated requirement at the spring line of the arch, as at b. The exterior boundary line of such a pier would be invariably *convex* outwardly. The manner of ascertaining the proper degree of convexity in any required pier is to divide the height of the pier into any desirable number of parts — equal or unequal — and to consider the lines of division as so many different bases, and find the extent of the horizontal arm for each base separately, then trace the line of curvature between the indicated points. It is not necessary that the permanent face of the pier shall remain possessed of this curvature, but only that such curve be regarded as a cautionary signal to the designer, perhaps disappearing when the final dimensions are reduced to consonance, with the judgment and intentions of the designer.

Before closing this communication we beg to be permitted one remark concerning something like advice, given to us by so many authorities commenting on arches as structural factors. I mean the importance which seems to be attached to the "depth of the keystone." From this, some pleasant fictions seem to have been romanticated as to the size of the voussoirs or archstones. Those authors, quoting from arches which, it seems, have been structurally successful, have laid down quite lengthy tables of the depths of keystones, and we are expected to take this advice as a fish might take a bait and swallow it. If the structure, based on this advice, is a success, we congratulate ourselves; if it fails, we, in part, excuse ourselves on

the score of precedent, and partly because of the alleged "dishonesty of the contractor," the "incapacity of the workmen," "treachery of the foundation," or some other ingenious fabrication.

The relation of keystones to voussoirs, or archstones, is this: They must not be of less depth than their next neighbor archstones, or such masses as may be employed to serve as archstones. If we take this view of it, there still remains importuning us for an answer the question, What should be the depth of the arch blocks, and how shall we determine this for any required instance?

We should approach the reply in this way: —

1. The weight the arch is to bear (the weight of its own mass included) as compared with the resistence to crushing which the material of which the arch is built possesses: in the same manner as the crushing strength of a vertical pier or wall is considered and determined; for, after all, an arch is only a wall or pier built more or less parallel to the horizon, instead of perpendicular to it.

2. By considering convenience as regards the conventionally or accidentally fixed masses of materials of which some arches are, and others may be built, such as brick, rough stones from the quarry, building tile, etc., etc., and then allowing reasonably for defections in materials and workmanship, — and "there are others."

By far the greatest number of arches are built stronger than the demands of their position are ever likely to require, and this because we do not care to reduce materials to exact dimensions that we may know to be necessary. We take such as we find ready to hand which will serve. This is true particularly of all arches of little span and bearing little weight.

It is only when we have the shaping of the material, both as to dimension and form, subject to our judgment and order that the question seriously presents itself, How much *must* we have? or, How little can we with safety employ? Then the suggestion 1 above becomes pertinent.

But in any event the *strength* of the arch is not ascertainable from a made-for-stock "keystone." It is better to make the keystone to suit the arch requirements; *i. e.*, if a "keystone" is at all permissible as an especially honored or conspicuous member of the brotherhood composing the arch. Of course we find the center and highest part of an arch a most tempting (because of precedent) place on which to hang the conceits we call "ornaments" or "decoration," and for this reason we often go a great way around to mask our purpose.

And when it happens that our purposes are a long time masked, superstition, like a spider, weaves many fantastic webs around them, so as finally to effectually conceal the underlying motive or render a correct interpretation almost impossible. For these reasons we wander sometimes long amid a labyrinth of uncertainties, making pursuit after many will-o'-the-wisps, but not readily finding our way out.

Another curious quandary we often find uneasily brooding. In form of question it is: WHAT RISE SHOULD AN ARCH HAVE? The popular mind is full of the idea that an arch, to be "strong," must have relatively great height above the tops of its piers. But this, like many other popular ideas, is a fallacy. But the arch with a great rise above its springing is more easily destroyed than a popular fallacy.

The least *rise* an arch has, when its supports are competent, the stronger the structure will be. Then the question propounded above must of necessity change its form and become, What is the least rise sufficient for full structural efficiency in an arch?

We would answer that the least rise must not be less than the equivalent of *compression* under the greatest weight to be borne.

Taking it for granted that some curve may be traced through component parts of an arch, it follows that the arc is longer than a straight from one extremity of the arc to the other. It is self-evident that the longer line would not pass through the space occupied by the shorter one. Therefore the arch could not drop through the void it spans. But if by any means the length of the arc be shortened to a length less than the straight line between its extremities, then it will readily drop into the void. This, it seems to us, is the whole essence of the philosophy involved in the relation between the rise and span of an arch.

Recent Brick and Terra-Cotta Work in American Cities, and Manufacturers' Department.

NEW YORK. — A state of midsummer quietness seems to be prevalent in this city, but it is no more than should be expected, and is not an alarming condition of affairs. On the contrary, the outlook for the coming fall and winter is very bright, and even the architects, who are not busy now, seem to be sanguine as to the future and what it will bring forth. There seems to be no reason why this city should not share in the good times which are sure to follow, with the tariff law settled and confidence restored.

The coming election for the first mayor of Greater New York will undoubtedly cause considerable excitement, and possibly some interference with business; but this will be counteracted by the feeling everywhere prevalent that the city will be benefited ultimately by consolidation.

Among the items of new work which have been reported are: —

A five-story brick and stone tenement at Nos. 104 to 106 Second Street, for Mrs. Van Alen, of Newport, R. I. Clinton & Russell are the architects.

An office building to cost $125,000, designed by C. P. H. Gilbert, architect, will be erected on the northeast corner of Broadway

TERRA-COTTA DETAIL, BUILDING FOR THE EVANS ESTATE, BUFFALO, N. Y.
E. A. Kent, Architect.
Executed by the Northwestern Terra-Cotta Company.

and Maiden Lane. It is interesting as showing the enormous value of real estate in this locality to note that this lot 30 by 50 ft., with the old five-story building which is now on it, was sold for $245,000.

R. Maynicke, architect, has planned a $250,000 office building to be erected on Broadway for Henry Korn.

McKim, Mead & White, architects, are making extensive alterations to the residence of ex-Secretary of the navy, Wm. C. Whitney. It is said that the alterations will cost $150,000.

Mr. Oliver H. P. Belmont has purchased a lot on the southeast corner of Fifth Avenue and 77th Street, for which he paid $150,000. The lot is 27 by 120 ft. Mr. Belmont intends to erect a handsome residence, but plans have not yet been prepared.

A. M. Welch, architect, has filed plans for one three-story and three two-story brick and stone stables and dwellings on 77th Street. Cost, $60,000.

H. J. Hardenburgh, architect, has drawn plans for a hotel to be erected at 54 and 58 Third Avenue. Cost, $400,000.

Dehli & Howard, architects, have planned an academy of music for the Apollo Club, of Brooklyn, to cost $600,000. The site has not yet been selected.

Buchman & Diesler, architects, have completed plans for a twelve-story store and loft building, to be erected on Broadway, between Prince and Houston Streets, and to cost $800,000.

CHICAGO.— Bids on anything in the building line can be obtained at remarkably low figures. Contractors who formerly awaited invitations are now soliciting opportunities to

RESIDENCE AT MADISON, N. J.
Clinton & Russell, Architects.

figure. There is, however, a brighter feeling, and building is on the increase, though the increase is slow. As the political economist would term it, the improvement is a conservative, healthy one.

We repeat ourselves, as the facts are doing, when we say that the greatest part of the building activity is in small flat buildings, which can be seen springing up even in the outlying districts of Chicago. The greater number of these cost from $7,000 to $12,000 or $15,000. One, costing $35,000, may head the column of building news, while $75,000 to $100,000 figures often get extended description.

Alterations of stores and commercial buildings have been referred to as an important feature of building operations in this city this year. The remodeling of one hotel is just being completed, and that of three more well-known hostelries will soon be under way, under the direction respectively of Jenney & Mundie, Wilson & Marshall, and W. W. Boyington & Co.

Holabird & Roche have let contracts for a commercial building, seven stories high, to be erected near the new public library.

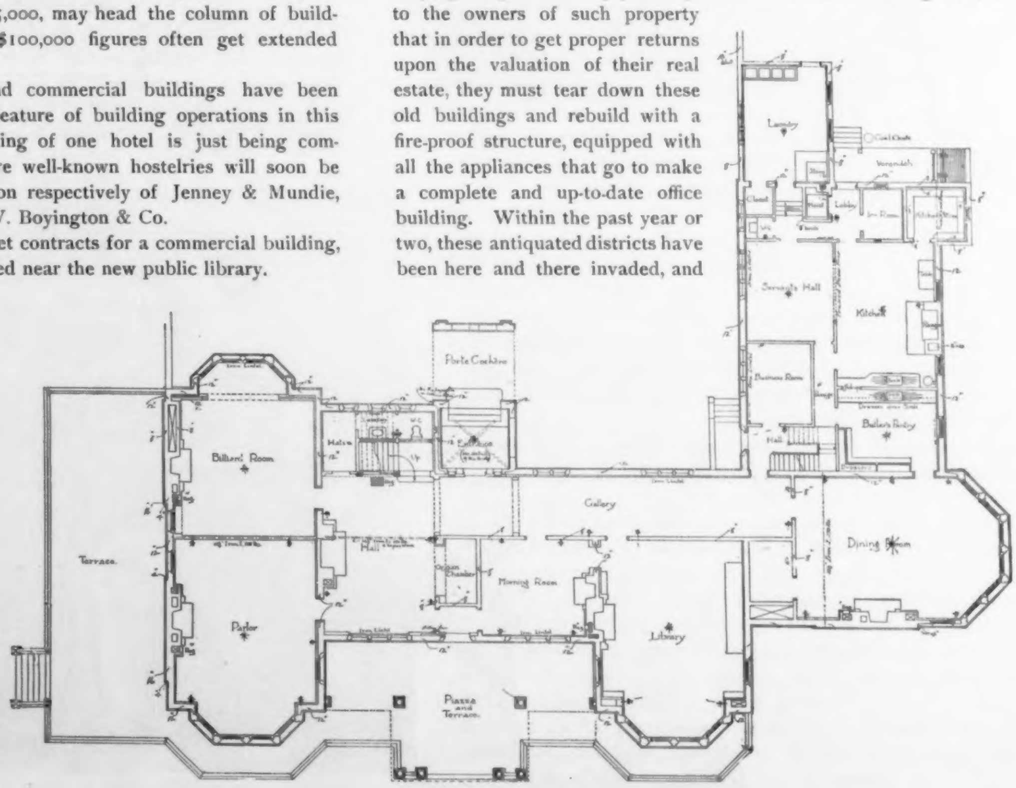
The one building project which interests the general public in Chicago is the Post-Office Building. The old one did finally disappear, and now the site is a desert waste — a lonely looking excavation a block square, surrounded by a dense business population. A contract has just been let, however, to McArthur Brothers, some $235,000 in amount for foundation work, and they will begin soon to drive piles.

The old post-office had continuous foundations of heavy concrete so well built that they had to be blasted out. They rested on a bog, however, and the unequal loading caused serious trouble. The foundations of the new building are not to be of the isolated type, but, like those of the public library, where the consulting engineer was the same, Mr. Sooy Smith, will be piles. They are to be of Norway pine, and the contract requires that they be driven to bed rock 103 ft. below the street level.

Some two hundred thousand, more or less, Chicago bicyclers are beginning to pay their $1 each for license tags, in pursuance of a recent ordinance. The architects have not as yet begun to pay their $50 apiece for their license tags, in accordance with the new State law.

The Pioneer Fire-proof Construction Company lately lost one of their factories by fire. This may have been a satirical joke on the part of the little red devils, but we are pleased to know that the company's business will not be seriously interfered with.

BOSTON.—While there is not a great deal in sight at the present time in the way of new building operations, yet there is every reason to believe that Boston is on the eve of a very active period in this respect. Real estate owners are beginning to feel the demand on the part of their tenants for better accommodations, and the old-time buildings are fast being vacated because of the decided preference given to modern structures by the majority of business men renting offices. It is doubtful if any of the other large cities have as large a proportion of antiquated buildings located on valuable business sites as has Boston. The commercial heart of the city is largely made up of just such structures, varying in age from forty years upward. It is now becoming evident to the owners of such property that in order to get proper returns upon the valuation of their real estate, they must tear down these old buildings and rebuild with a fire-proof structure, equipped with all the appliances that go to make a complete and up-to-date office building. Within the past year or two, these antiquated districts have been here and there invaded, and



FIRST FLOOR PLAN, RESIDENCE AT MADISON, N. J.
Clinton & Russell, Architects.

modern buildings of attractive appearance have been, or are now being erected, which, by force of contrast, make the old structures

RESIDENCE, WOODLAWN AVE., COLUMBUS, OHIO.
H. A. Linthwaite, Architect.
Built of Gray Roman Brick, manufactured by the Columbus Brick & Terra-Cotta Company.

less desirable than ever. The effect of this will, we believe, be soon evinced by a general rebuilding of these localities, especially now that the improvement in business conditions warrants investors in going ahead with enterprises of this nature.

The erection of the South Union Terminal Station along the lines of Summer and Federal Streets greatly increases the valuation of property in that section, and, to some extent at least, will alter the character of business on the streets mentioned, and also in the immediate neighborhood of the station. Owners of real estate on the line of Summer Street anticipate that their properties will become valuable sites for retail establishments, and should this prove true, it will cause, within the next few years, a general rebuilding of that street.

Work on the station itself is rapidly progressing, and notwithstanding the many unforeseen obstacles encountered, the contractors are already ahead of their contract. Superintendent Clark states that they will doubtless begin to lay front brick on the main building at the Summer Street corner by the middle of September. Unless something unforeseen occurs, there is little doubt but that the station will be ready for occupancy by the fall of 1898.

Among the new buildings, either now under process of construction, or on which work will be shortly begun, may be mentioned the following: —

The Jeweller's Exchange (office and retail store building) situated at the corner of Bromfield and Washington Streets, Winslow & Wetherell, architects; Fuller Construction Company, of Chicago, contractors; to be constructed of brick and terra-cotta. The Russia Building (mercantile), Atlantic Avenue and Congress Streets, Peabody & Stearns, architects; C. Everett Clark, contractor; to be constructed of brick. Converse Building (office building), Pearl and Milk Streets, Winslow & Wetherell, architects; L. P. Soule & Son, contractors; to be constructed of brick and terra-cotta. Paul Revere School Building, Peabody & Stearns, architects; W. S. Sampson & Son, contractors; to be constructed of mottled brick and gray terra-cotta. Bath-house for the city of Boston, Peabody & Stearns, architects, James Fagan, contractor; to be constructed of mottled brick and gray terra-cotta. Brookline Real Estate Trust Building (a $250,000 fire-proof apartment hotel) at Brookline, Winslow & Wetherell, architects; T. S. Robbins, Worcester, Mass., contractor; to be constructed of brick and terra-cotta. St. John Parish Church, East Boston, Martin & Hall, architects, Providence, R. I.; W. L. Clark & Co., contractors; to be constructed of brick and terra-cotta. Cambridge Savings Bank Building, Cambridge, Mass., C. H. Blackall, architect; Norcross & Cleveland, contractors; to be constructed of brick and terra-cotta. Puffer Building (mercantile), Harrison Avenue and Essex Street, Rand & Taylor, Kendall & Stevens, architects; to be constructed of terra-cotta and limestone. Solid terra-cotta front above the second story. Masonic Temple, Boylston and Tremont Streets, Loring & Phipps, architects. Fire-proof building; to be constructed of brick. $200,000 apartment hotel, Brookline, Mass., E. D. Ryerson, architect; to be constructed of brick and stone. $630,000 apartment block, Back Bay, Henry E. Grieger and John Addison, architects, Chicago; to be constructed of brick and terra-cotta. Residence for Earnest W. Bowditch, at Milton, Mass., architects, McKim, Mead & White; C. Everett Clark, contractor; to be constructed of brick. $150,000 dormitory, Cambridge, Mass., Coolidge & Wright, architects; to be constructed of brick; fire-proof building. $120,000 apartment hotel, Back Bay, Charles E. Park, architect; to be constructed of brick. $60,000 schoolhouse, Somerville, Mass., Aaron H. Gould, architect; to be constructed of brick. $130,000 apartment hotel, Back Bay, H. B. Ball, architect; to be constructed of brick. $500,000 office building, corner Somerset and Beacon Streets, Boston; Congregational Publishing Club, owners; Shepley, Rutan & Coolidge, architects; to be constructed of stone. New brewery for the Puritan Brewing Company, Charlestown, Mass., Hettinger & Hartman, archi-

BRICK AND TERRA-COTTA RESIDENCE, PITTSBURG, PA.
Beezer Bros., Architects.

tects; Mack Brothers, of Salem, contractors; to be constructed of red brick. $150,000 addition to the Insane Hospital, at Worcester, Mass., Fuller, Delano & Frost, architects, Worcester; to be constructed of

CARTOUCHE PANEL, NEW YORK AND NEW JERSEY TELEPHONE BUILDING, BROOKLYN, NEW YORK.
R. L. Daus, Architect.
Executed by the Perth Amboy Terra-Cotta Company.

brick and stone. $30,000 church, Exeter, N. H., Cram, Wentworth & Goodhue, architects. Revere town hall, Revere, Mass., Greenleaf & Cobb, architects; W. L. Clark & Co., contractors; to be constructed of red brick and gray terra-cotta.

ST. LOUIS. — The report of the Commissioner of Public Buildings for the last month shows an increase in the number of permits issued, and also for a better class of buildings. This, for one of the dullest months in the year, affords considerable encouragement, and the feeling seems quite general that there will be a steady improvement in business throughout the year.

The most important happening in this part of the architectural world of late, perhaps, has been the competition for the St. Louis Club. A short time ago the club, becoming dissatisfied with their present location at 29th and Locust Streets, which is a most interesting piece of Romanesque work, by Peabody & Stearns, selected a site on Lindell Boulevard, which extends through to Olive Street.

Architects Eames & Young, M. P. McArdle, and Shepley, Rutan & Coolidge, of this city, and Arthur J. Dillon, of New York, were invited to submit plans, and Mr. Dillon's plans were selected. The design is in the French Renaissance, two story and attic high. On Olive Street an entrance and gate lodge will add to the attractiveness of the surroundings. Some comment has been made concerning the action of the committee in selecting Mr. Dillon's plans, as 'tis said the instructions were that the building should be designed in the Italian Renaissance, but it seems by the employment of the French style, and the placing of the banquet hall in the high roof, the architect was enabled to get the required amount of space with a very much reduced cubic area, which, doubtless, influenced the committee very materially in their decision. The building is expected to cost between $125,000 and $150,000.

During the past three years quite a number of schemes have been in contemplation for the improvement of the northeast corner of Olive and Sixth Streets, which have taken more or less definite form, but eventually fell through, and the last proposition, which was to build a sixteen-story office building, and for which a permit was taken out before the ordinance, limiting the height of buildings, went into effect, seems to have shared the fate of all others after the old buildings had been partially wrecked.

Shepley, Rutan & Coolidge are preparing plans for a nine-story fire-proof building, to be built on the southeast corner of St. Charles and Tenth Streets, for the Imperial Lighting Company. The lower floors are to be used for the machinery, and the upper floors for offices.

TERRA-COTTA PANEL, RESIDENCE, BROAD STREET, PHILADELPHIA, PA.
Hazelhurst & Huckel, Architects.
Executed by the Conkling, Armstrong Terra-Cotta Company.

TERRA-COTTA DETAIL, OFFICE BUILDING, WALL STREET, NEW YORK CITY.
Jardine, Kent & Jardine, Architects.
Executed by the New Jersey Terra-Cotta Company.

PITTSBURG.— Activity in the building line has been very brisk the past month, and much more work is looked for in the near future. Most of the new work is in the East End, consisting mainly of first-class residences and several good churches. Architect W. A. Thomas is preparing plans for a fifteen-room buff brick colonial residence on Fifth and Shady Avenues, also a twelve-room brick dwelling on Rebecca Street, for Mrs. R. Davis.

Architect E. B. Milligan is preparing plans for two brick dwellings in the East End for Reed B. Coyle, Esq., one a fifteen and the other an eleven-room building; also two brick dwellings for Dr. Connell, at Oakland.

Architect E. M. Butz is preparing plans for a $20,000 colonial dwelling on Wightman Street, for Colonel Robinson.

Architect T. D. Evans has prepared plans for four brick dwellings, to be erected on Elgin near Highland Avenue, for Jno. Fite, Esq.

Architects Alden & Harlow have closed the contract for the erection of a two-story brick resi-

dence for J. C. Jennings, Esq., Fifth Avenue and Lilac Street, to cost $20,000.

Architects Struthers & Hannah are preparing plans for a brick military drill hall for Grove City College.

Architects Rutan & Russell have prepared plans for a warehouse for the Hayes estate, to be erected on Liberty Street.

Architect Charles Bickel is preparing plans for a five-story apartment building.

Architect L. H. Raisig is preparing plans for a row of store and apartment buildings, to be erected at Homestead, for Dr. McCaslin, of that place.

IMPOST CAP, ENTRANCE BOHEMIAN CLUB, NEW YORK CITY.
Julius Franke, Architect.
Executed by the Excelsior Terra-Cotta Company.

A NEW SIDEWALK LIGHT.

A DESIGN for a new sidewalk vault light has been gotten out by the American Mason Safety Tread Company, whose non-slipping specialty has now become so well known among architects. The new light, of which a cut is given in the advertising columns of THE BRICKBUILDER, page xxxvi, this month, seems to be, in many of its features, an advance over any now in use. In the first place, its surface is protected by strips of lead under the Mason patent against the possibility of becoming slippery, a very distinct improvement, when the cost and annoyance of the iron pegs usually used is considered, and that in a busy place they wear so rapidly that they require to be renewed frequently. The lead strips are sufficiently near together to furnish absolute security against slipping, and experience has shown that even rain or light snow does not neutralize this advantage. The largest lighting area consistent with strength is given, and to secure the glasses against breakage by the action of frost, they are set with a special lead cement. It is the purpose of the company to furnish the best and safest light possible to be made, and the enterprise will surely enlist the interest of architects, who have long been conscious of the imperfections of the light now used. The company will send a full-size blue print on application.

TERRA-COTTA DETAIL, BANK BUILDING, DOYLESTOWN, PA.
Baker & Dallett, Architects.
Executed by the Conkling, Armstrong Terra-Cotta Company.

WITH THE BUSY.

T. W. CARMICHAEL claims to have invented a clay screen which has two or three times the capacity of any screen on the market.

O. W. PETERSON & Co., Boston, Mass., are furnishing the brick on the Robinson Street School, Dorchester, Mass., A. Warren Gould, architect; also on the Registry of Deeds Building, Cambridge, Mass., Olin W. Cutter, architect.

CHAMBERS BROTHERS COMPANY, Philadelphia, report a very gratifying interest in their exhibit of brick-making machinery on the part of visitors to the Tennessee Centennial, at Nashville, and state that they have already pocketed some orders as an indirect result of this exhibit.

T. W. CARMICHAEL, Wellsburg, W. Va., has shipped the fourteenth clay steamer for this season. The last shipment was to Christiania, Norway, in response to an order by cablegram.

RUFUS E. EGGLESTON, Philadelphia, has just closed a contract for the furnishing of the Gale Automatic Sash Locks and the Bolles Revolving Windows in the new building for the Bell Telephone Company of that city, 11th and Filbert Streets; Charles McCaul, builder.

CELADON ROOFING TILES, Charles T. Harris, lessee, have been specified for the following: —

Residence for T. B. Crary, Binghamton, N. Y. Residence for G. W. Griswold, Hornellsville, N. Y. Home for the I. O. O. F., Springfield, O., Yost & Packard, architects.

BEST BROTHERS' Keene's cement (for which Fiske, Homes & Co., Boston, are exclusive agents) has been specified for over fifty apartment houses, business blocks, and residences now being erected, and about one hundred having been plastered either wholly or partially with it during the past eighteen months.

THE new Houghton & Dutton building on Tremont Street and Pemberton Square, Boston, is being supplied with white mottled brick, manufactured at Fiske, Homes & Co.'s factory, South Boston. The architectural terra-cotta and the fire-proofing, and the lime and cement are also being furnished by them.

CONTRACTS have been closed for placing the Bolles Sliding and Revolving Sash in Dr. Kelly's Hospital, and an office building, corner Lexington and Davis Streets, Baltimore, also in a large residence in Hagerstown. The warehouse of George Blome & Son will be fully equipped with these improved sashes within the next month.

THE ZANESVILLE MOSAIC TILE COMPANY, of Zanesville, Ohio, are furnishing, through their Boston agents, O. W. Peterson & Co., the tiles for the apartment house of A. Bilafsky, on Beacon Street. The tiles will be used in twenty-four bathrooms, seventy-two fire-places, and in the main halls and vestibules.

THE PERTH AMBOY TERRA-COTTA COMPANY have recently closed the following contracts for architectural terra-cotta: —

Church and Clergy House, 88th Street, between First and Second Avenues, New York, N. Y., Messrs. Barney & Chapman, of New York City, architects. New York Telephone Building, 30, 32, and 34 Gold Street, New York, N. Y., Mr. Cyrus L. W. Eidlitz, of New York City, architect. Addition to Crotona Park Public Build-

ing, Crotona Park, N. Y., Mr. George B. Post, of New York City, architect.

The New Jersey Terra-Cotta Company, of New York, have secured through G. R. Twichell & Co., Boston, their New England agents, the contract to supply the terra-cotta on the Brewer Building, Worcester, Mass. George H. Clemence, architect, Worcester. Norcross & Cleveland, contractors, Boston. Terra-cotta to be of a salmon shade.

The Cummings Cement Company, with works of enormous capacity at Akron, N. Y., are running one quarter overtime, in an endeavor to keep pace with the rapidly increasing demand for its rock and Portland cements, the larger share of which is being used for street paving in Buffalo and other large cities in New York and Pennsylvania.

The Hydraulic Press Brick Company, St. Louis, have just secured a contract for over three hundred thousand enameled bricks for the interior of the Burlington depot at Omaha, Neb. They are also putting on the market a white face brick with a surface that is impervious, and when soiled can be cleaned with soap and water. The surface is not glazed.

The Excelsior Terra-Cotta Company, through their Boston representative, Charles Beacon, have closed the following contracts for architectural terra-cotta: Converse Building, Boston; Winslow & Wetherell, architects; L. P. Soule & Son, builders. Cambridge Savings Bank, Cambridge, Mass; C. H. Blackall, architect; Norcross & Cleveland, builders.

Messrs. Frank Sears, of New York, and Charles B. Sears, of Chicago, formerly managers of the business of the late James Brand, in association with Mr. Wm. S. Humbert, of Buffalo, N. Y., will continue in that long-established business, under the style of Sears, Humbert & Co., with offices in New York City, Buffalo, and Chicago. The new firm will continue the importation of the La Farge, Josson, and Burham Portland cements, and will, besides, repre sent the American Cement Company in the West.

The Powhatan Clay Manufacturing Company's bricks are now being used in the store and loft building at 39th Street and Fifth Avenue, business building at Forsyth and Hester Streets, flats at 143d Street and Seventh Avenue, interior of laundry of St. Joseph's Orphan Asylum, 401 E. 89th Street, all of New York City.

They have recently closed the contracts for the kindergarten at Rivington and Cannon Streets, flats on 117th Street, near Lenox Avenue, and the business building at 590 Broadway, New York City.

In all of the above the brick is their cream white.

The Eastern Hydraulic Press-Brick Company have recently furnished their iron-spot bricks for lining the interior of one of the handsomest churches in Rochester, N. Y.,— St. Paul's Episcopal. They are also just completing a contract for furnishing their gold-colored bricks for lining the interior of the St. Stephen's Episcopal Church, at Wilkesbarre, Penn. Those who have seen the effect pronounce it beautiful, and, as it is somewhat of a departure, it will be of interest to our readers, and should lead to an increased use of light-colored bricks for the interior of churches and other large public buildings.

Conkling, Armstrong Terra-Cotta Company, through their New England agent, Charles E. Willard, have secured the contract to supply the terra-cotta for Times Building, Hartford, Conn., George B. Rogers, architect; the St. Anne Church, Somerville, Mass., Keeley & Houghton, architects, Brooklyn, N. Y., S. Brennan & Co., contractors; the A. D. Puffer Building, 1651 Washington Street, Boston, A. H. Nelson, architect; the Paul Revere School, Boston, Peabody & Stearns, architects; the Revere Town Hall, Greenleaf & Cobb, architects; and the new building for the Puritan Brewing Company, Charlestown, Mass., Hettinger & Hartmann, architects.

Chicago Terra-Cotta Roofing and Siding Tile Company report the following buildings completed last month, on which their goods were used for roofing:—

Residence, Buffalo, N. Y., Swan & Faulkner, architects, French tile. Residence, Titusville, Pa., C. W. Terry, architect, Oil City, Pa., small Spanish. Residence, Calumet Avenue, Chicago, S. B. Eisendrath, architect, French tile. Apartment Building, Wright Street, Chicago, Anderson & Gelin, architects, French tile. Residence, Douglas Boulevard, Chicago, Burtar & Gassman, architects, small Spanish. Memorial Church, Wheeling, W. Va., Franzheim, Giesey & Faris, architects, Spanish. Residence, Key West, Fla., large Spanish tile. Residence, St. Louis, A. M. Baker, architect.

Mr. Ross F. Tucker, the Manager of the Manhattan Concrete Company, has been awarded the contract for completing the several splendid buildings at the University of Virginia, of which Messrs. McKim, Mead & White are the architects. The Manhattan Concrete Company has a large contract for elaborate ornamental concrete on these buildings. The Manhattan Concrete Company has just finished a large contract on the Mills Houses, Bleeker, Sullivan, and Thompson Streets, New York, Ernest Flagg, architect. The work covered under this contract consisted of all floors and roof, 149,000 sq. ft. These floors were built for the most part in cold weather last winter, without the loss of a single foot. All floors throughout were finished with "Granitoid" similar to that being put down by this company on Boston Common, but of finer texture. The basement areas are lighted by the Manhattan Vault Light, a very superior and excellent construction. The building as a whole is a fine example of what can be done with concrete when properly used.

Sayre & Fisher Company, through their Boston representative, Charles Bacon, have closed the following contracts for supplying bricks.

Revere Beach Bathing Establishment, Revere, Mass.; pink brick and enamel; Stickney & Austin, architects, W. T. Eaton, contractor.

Real Estate & Trust Company Building, Atlantic Ave., Boston, mottled brick (gray); Peabody & Stearns, architects, C. E. Clark & Whitney, contractors.

West End Power House, Cambridge, Mass., white enameled brick; W. E. Whidden & Co., contractors.

Converse Building, Milk Street, pink brick; Winslow & Wetherell, architects, L. P. Soule & Son, contractors.

Cambridge Savings Bank, Cambridge, gray brick; C. H. Blackall, architect, Norcross & Cleveland, contractors.

Apartment house, Brookline, mottled brick; C. E. Dark, architect, E. F. Staples, contractor.

White Building, Boylston Street, white enameled; Winslow & Wetherell, architects, L. P. Soule & Son, contractors.

Massachusetts Historical Society, Fenway, Boston; Wheelright & Haven, architects, L. D. Wolcutt & Son, contractors.

Messrs. Fiske, Homes & Co., Boston, report a satisfactory business in their brick specialties. The following schoolhouse buildings are being supplied:—

Springfield, Mass., high school, Hartwell, Richardson & Driver, architects. Melrose, Mass., high school, Tristram Griffin, architect. Cambridge, Mass., normal school, Hartwell, Richardson & Driver, architects. Marlboro, Mass., high school, C. E. Barnes & Co., archi-

tects. Hartford, Conn., grammar school, C. W. Brocklesby, architect. Gardner, Mass., grammar school, Barker & Nourse, architects. North Adams, Mass., grammar school. Newton, Mass., high school, Hartwell, Richardson & Driver, architects. All taking approximately 1,500,000 bricks.

Among the smaller orders booked are: —

Block of apartment houses, Blackwood Street, Boston; 40,000 bricks. Large apartment houses, Mountford Street, Boston; 75,000 bricks. Large apartment houses, Copeland and Warren Streets, Roxbury; 75,000 bricks. Apartment house, Forest Street and Mt. Pleasant Avenue, Roxbury; 25,000 bricks. Apartment house, Ruggles Street, Roxbury; 75,000 bricks. Block of apartment houses, Batavia Street, Boston; 60,000 bricks. Block of apartment houses, St. Germain Street, Boston; 55,000 bricks. Two business blocks, Haverhill, Mass., 25,000.

THE Cleveland, O., *Leader*, says: —

"Vitrified shale clay glazed is being successfully used as cattle guards on the Cleveland, Canton & Southern Railroad. The new material being stable, durable, and inexpensive will likely be adopted universally, not immediately, but gradually. Railroad officials have found cattle guards made of wood or metal unsatisfactory, it is said, for several reasons. It has been found necessary to replace the old-fashioned protectors frequently, and careful watching is required to keep them in repair and in position.

"About a year ago the Cleveland, Canton & Southern Company experimented with the vitrified shale clay guards, and the success that has attended their use has induced the management to adopt them on all parts of the line. Railroad officers state that the new invention promises to supersede the systems now in use, many advantages being claimed for the glazed vitrified shale clay. It is said to be less expensive than wood, and to cost about a fifth what iron guards cost, a feature which is advantageous in these days of economical railroading. The guard is composed of short sections fastened together with iron rods if desirable, but this is not considered necessary. Being glazed they do not need painting, and rains and winds keep them clean. The manufacturers of the guards have decided not to build a factory, but to send dies to a brickyard near where the order goes, thus saving transportation charges. It is claimed that almost any brickyard can make them when furnished the dies. The manufacturers are Cleveland and Canton men."

These guards are made on the machines of The American Clay-Working Machinery Company, of Bucyrus.

TREASURY DEPARTMENT, Office Supervising Architect, Washington, D. C., July 8, 1897. SEALED PROPOSALS will be received at this office until 2 o'clock P. M. on the tenth day of August, 1897, and opened immediately thereafter, for all the labor and materials required for the erection and completion (except heating apparatus, vault doors, and tower clock), of the United States Post-Office, etc., building at Paterson, N. J., in accordance with the drawings and specification, copies of which may be had at this office or the office of the superintendent, at Paterson, N. J. Each bid must be accompanied by a certified check for a sum not less than two per cent. of the amount of the proposal. The right is reserved to reject any or all bids, and to waive any defect or informality in any bid, should it be deemed in the interest of the Government to do so. All proposals received after the time stated for opening will be returned to the bidders. CHAS. E. KEMPER, Acting Supervising Architect.

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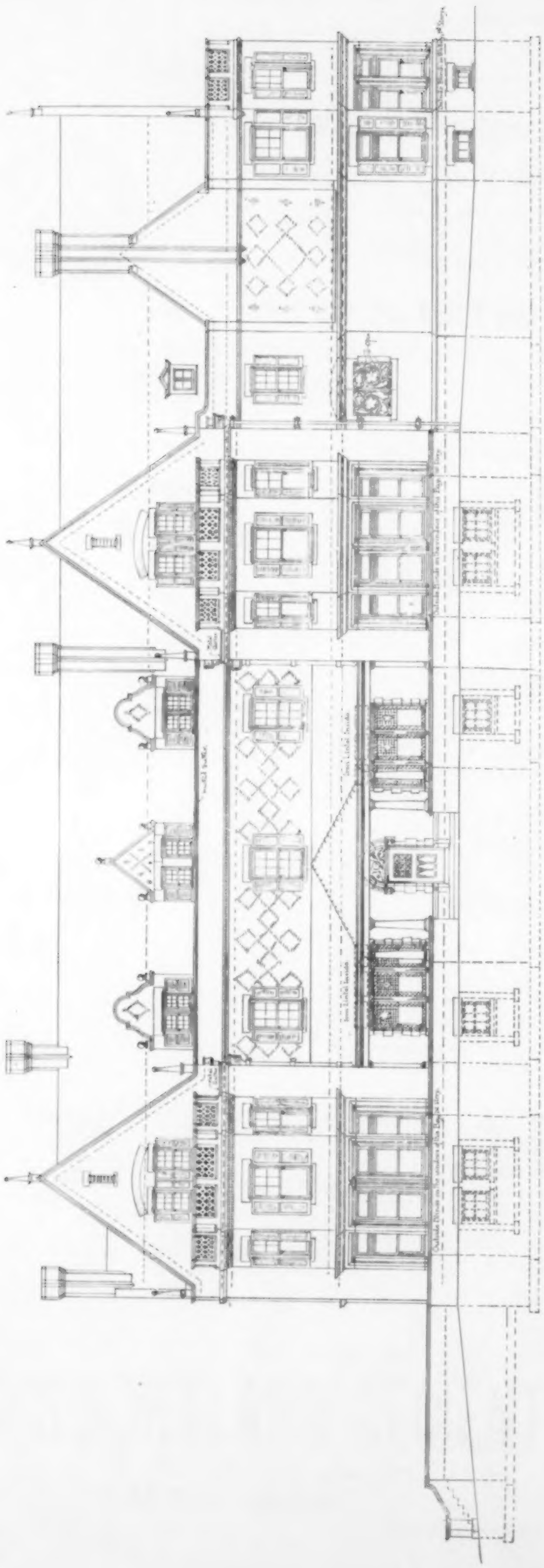
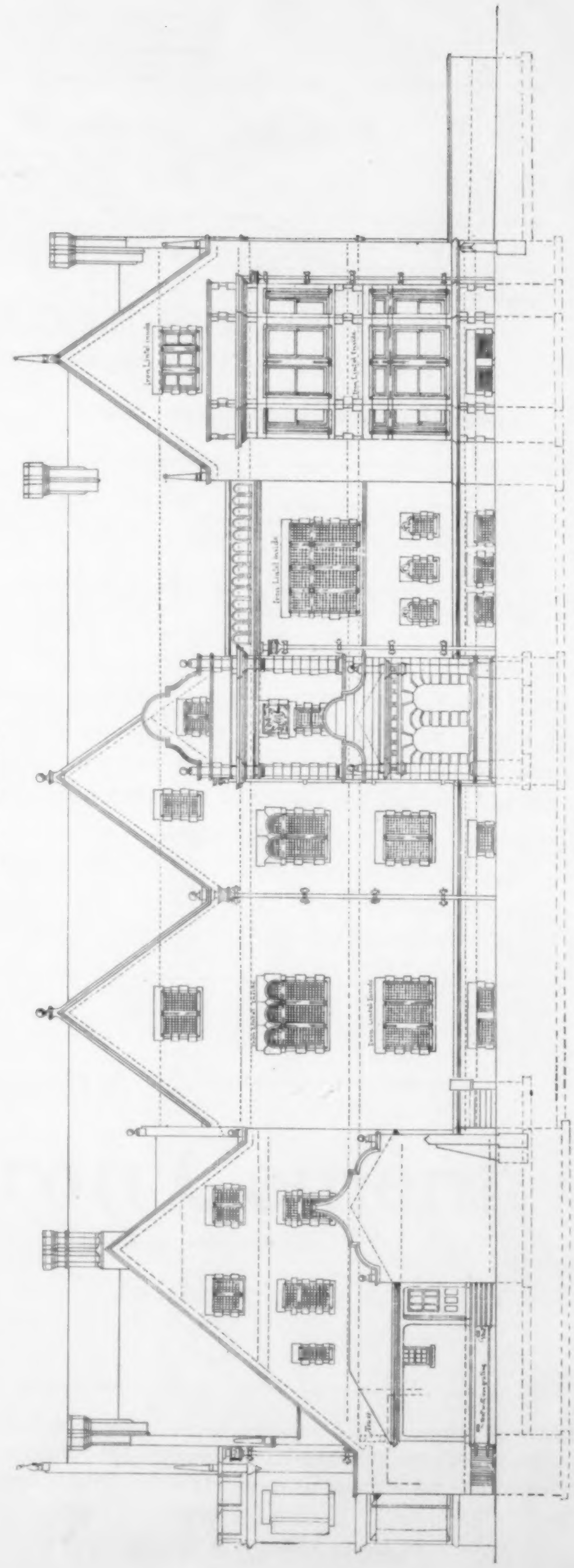


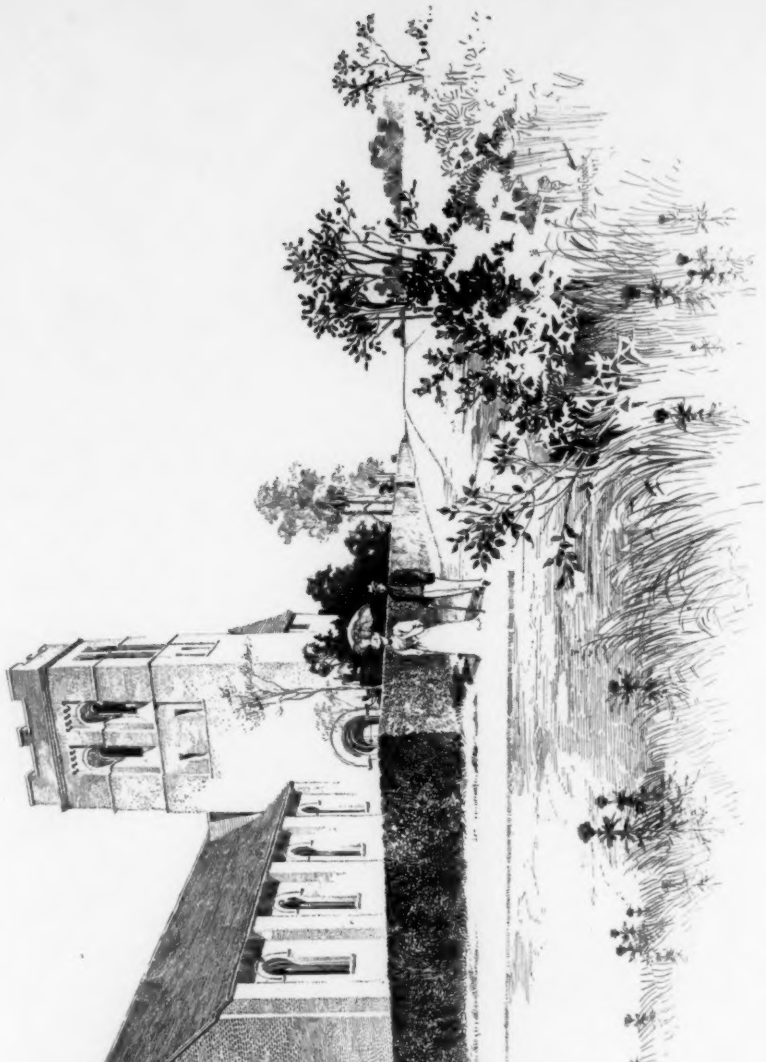
WEST ELEVATION.



EAST ELEVATION.

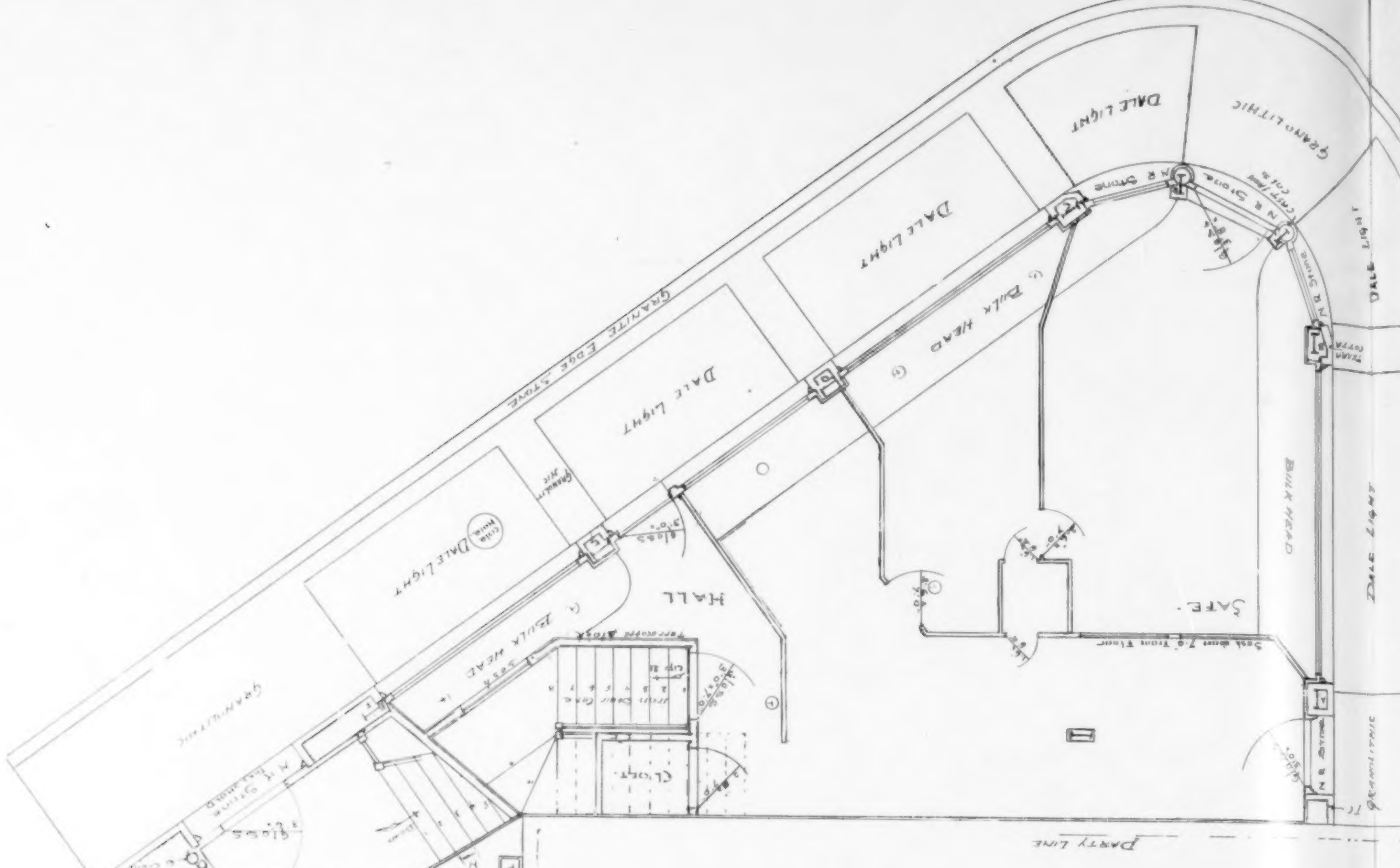
RESIDENCE AT MADISON, N. J.

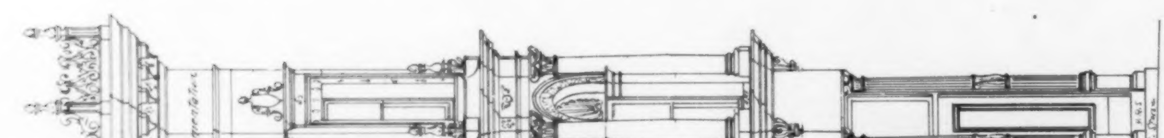
CLINTON & RUSSELL, ARCHITECTS.



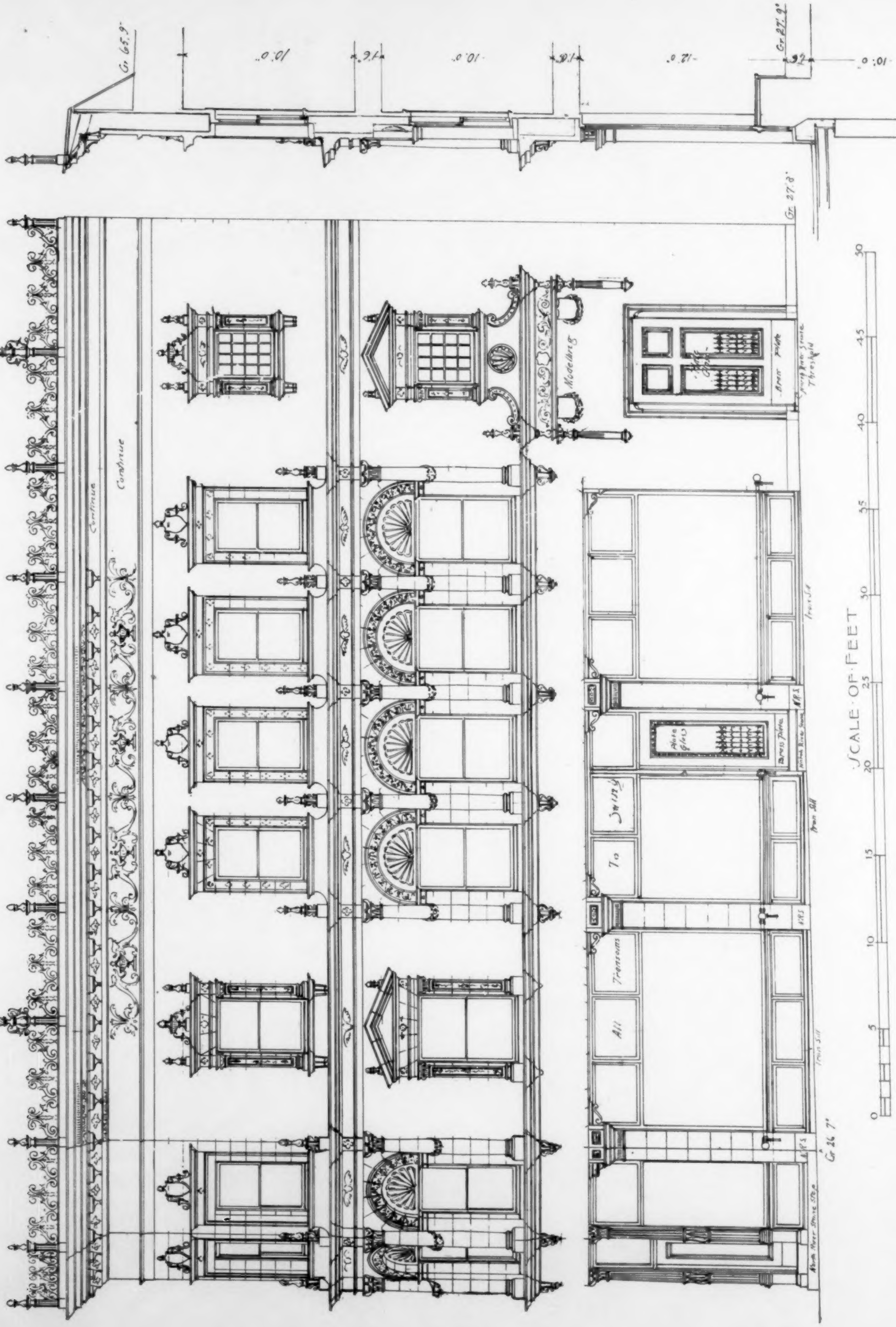
ST. ANDREW'S BY THE SEA EPISCOPAL CHURCH, EDGARTOWN, MASS.

CRAM, WENTWORTH & GOODHUE, ARCHITECTS.


DALE LIGHT
GRANITE EDGE STONE
GRANOLITHIC
BULK HEAD
HALL
SAFE
CLOSET
PARTY LINE

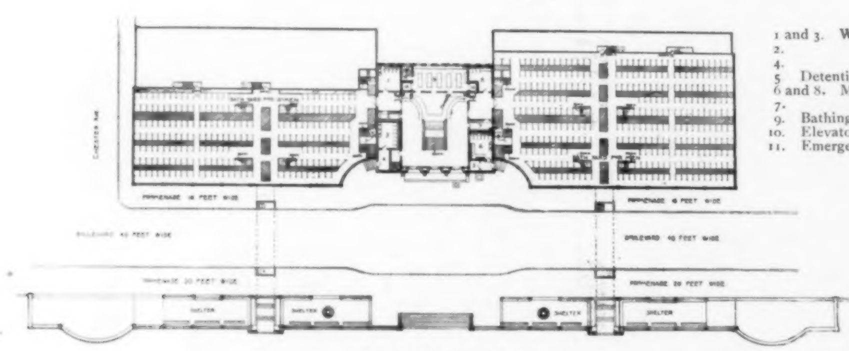


PLATES 67 and 68.



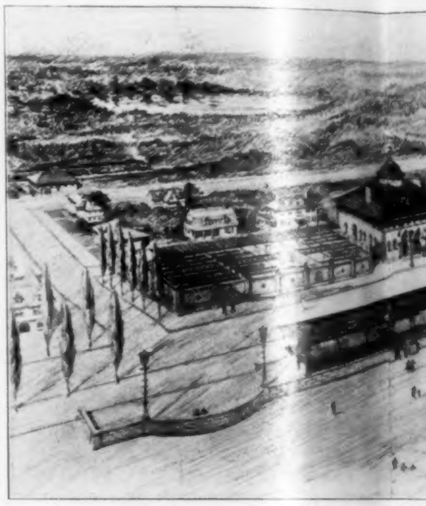
OFFICE BUILDING FOR THE PROCTOR ESTATE, BOSTON, MASS.

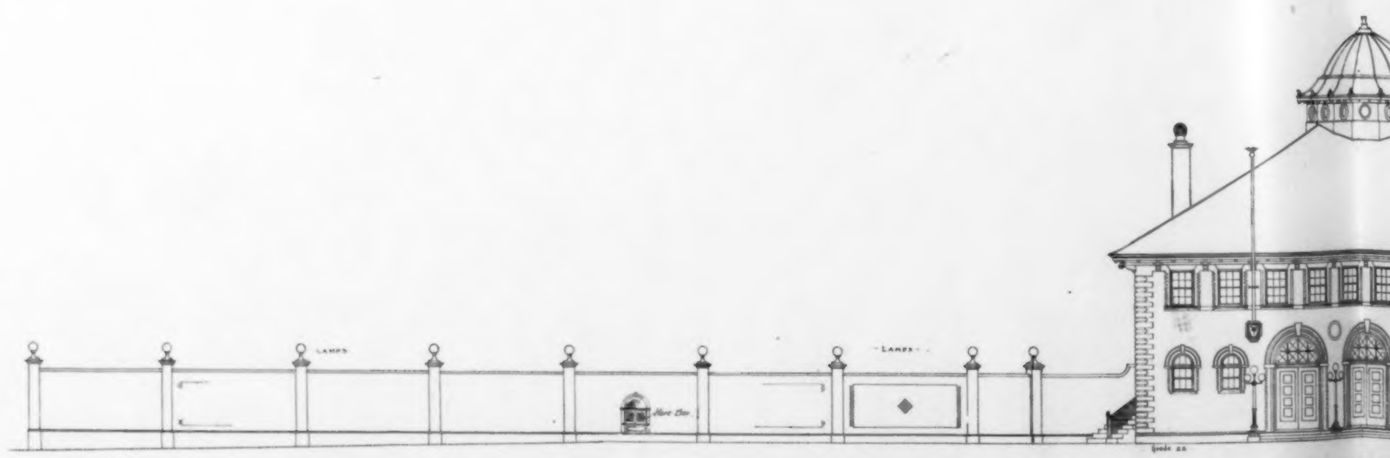
WINSLOW & WETHERELL, ARCHITECTS.



1 and 3. Women's Toilet Room.
2. ,, Valuables.
4. ,, Ante Room.
5 Detention Room.
6 and 8. Men's Toilet Room.
7. ,, Valuables.
9. Bathing Suit Room.
10. Elevators.
11. Emergency Doors.

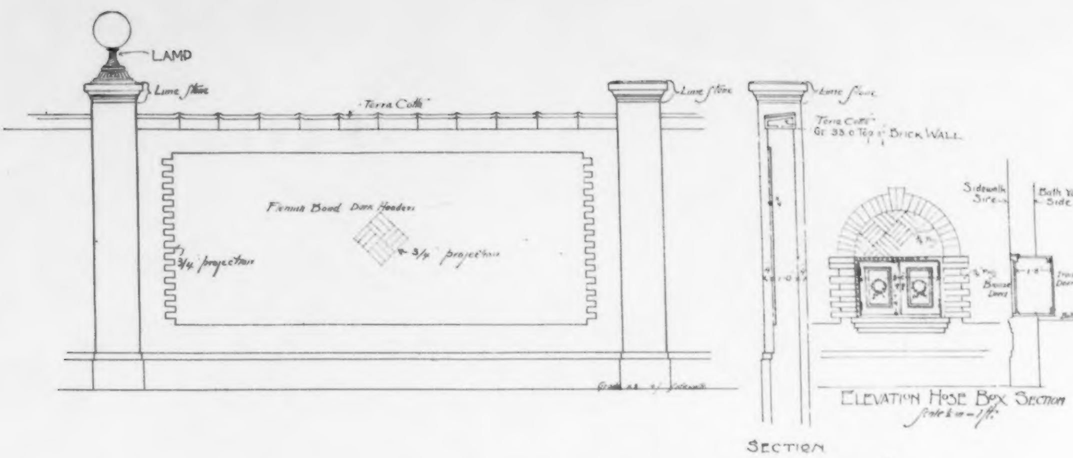
FIRST FLOOR PLAN.

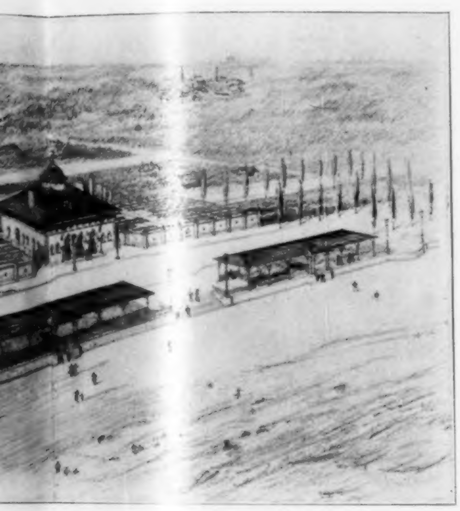


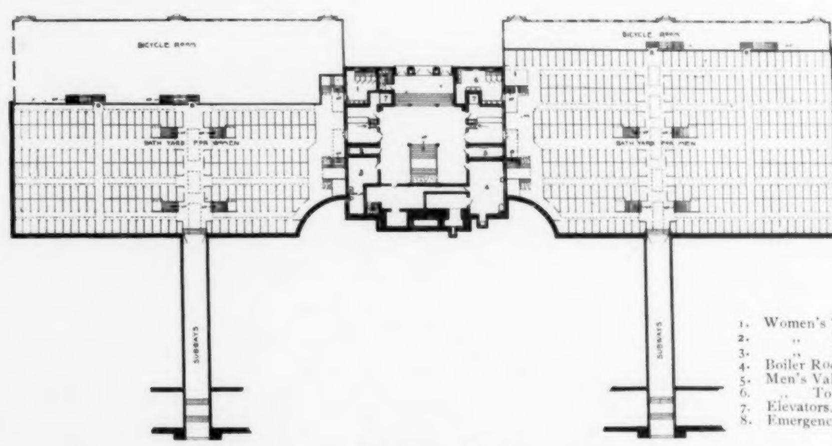


BATHING ESTABLISHMENT, SHELTERS AND

STICKNEY & AUSTIN,

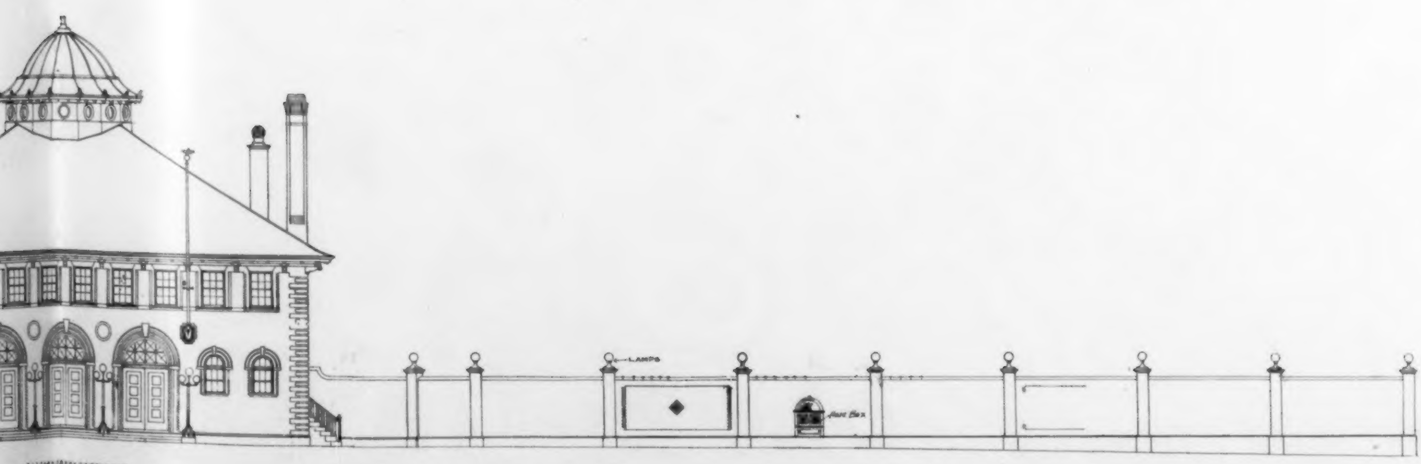






1. Women's Toilet Room.
2. ,, Valuables.
3. ,, Retiring Room.
4. Boiler Room
5. Men's Valuables.
6. ,, Toilet Room.
7. Elevators.
8. Emergency Doors.

BASEMENT PLAN.

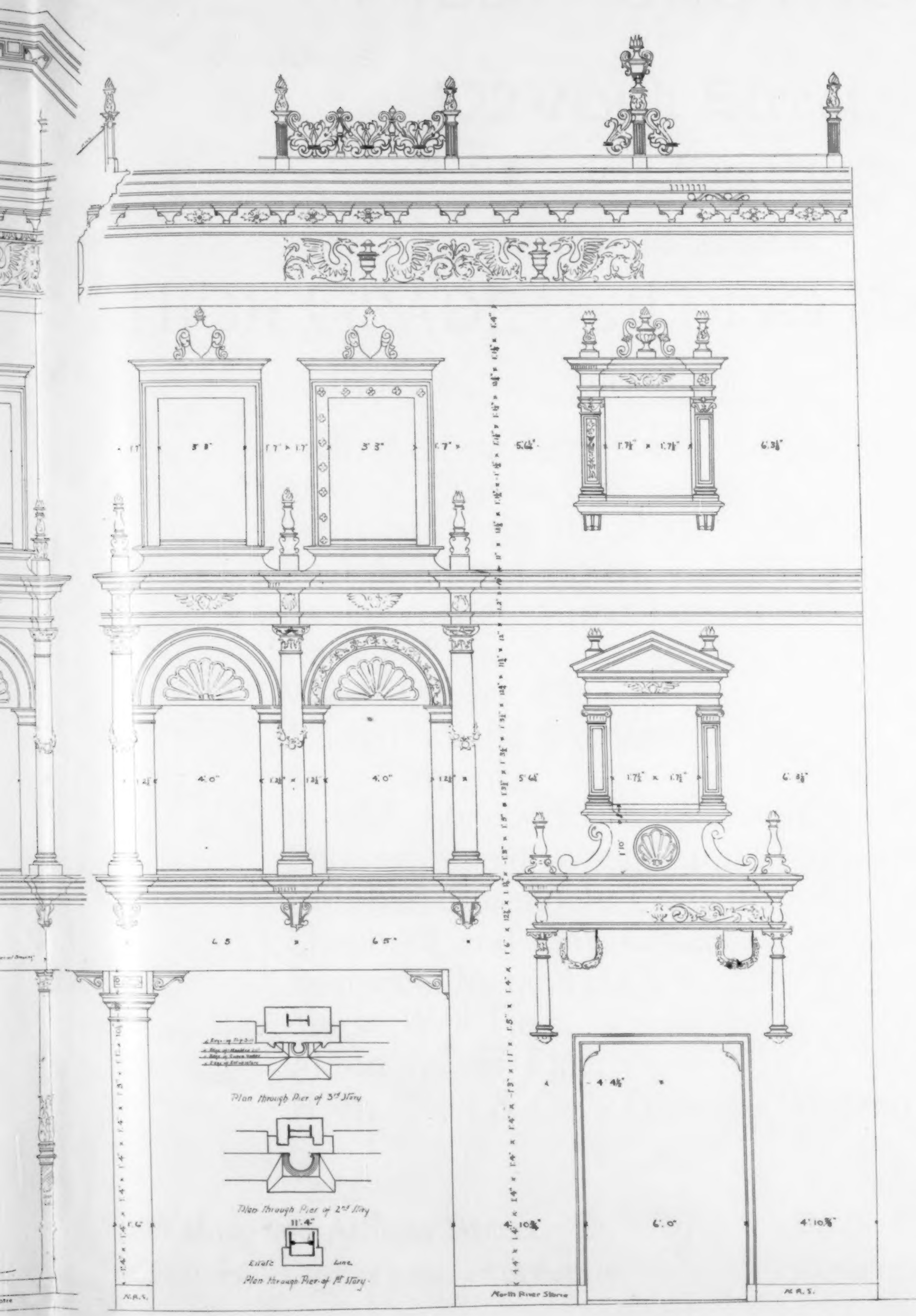


ELTERS AND SUBWAY, REVERE BEACH, MASS.

IEY & AUSTIN, ARCHITECTS.

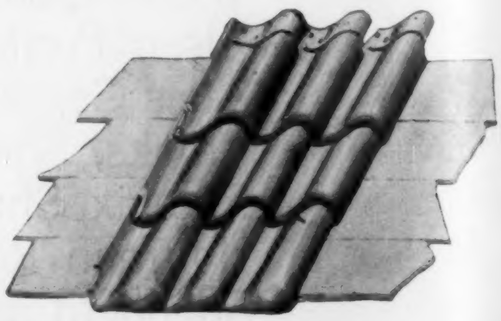
DETAILS, OFFICE BUILDING FOR THE PRO
WINSLOW & WETHERELL

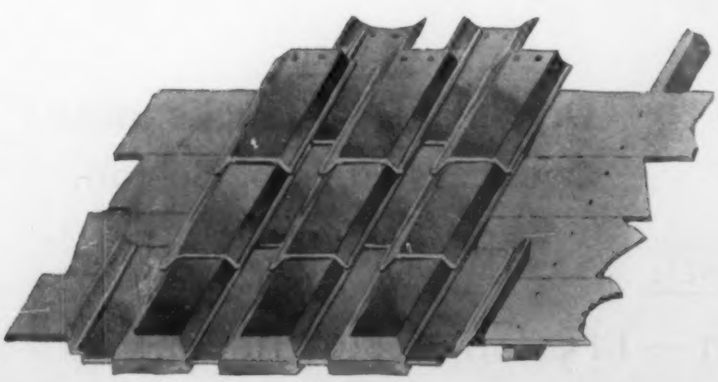
PLATES 71 and 72.

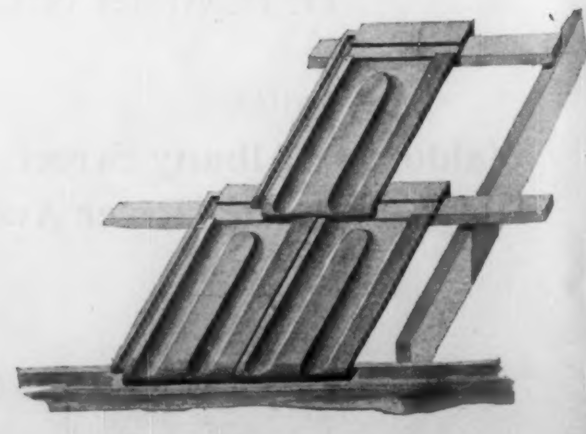


FOR THE PROCTOR ESTATE, BOSTON, MASS

& WETHERELL, ARCHITECTS.








NEW-YORK
ARCHITECTVRAL
TERRA-COTTA
COMPANY.
THIRTY EIGHT,
PARK ROW,
NEW YORK CITY.
PHILADELPHIA
BOSTON
CHICAGO